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MANAGEMENT

AND

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MANAGEMENT
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IN MANUFACTURING INDUSTRIES

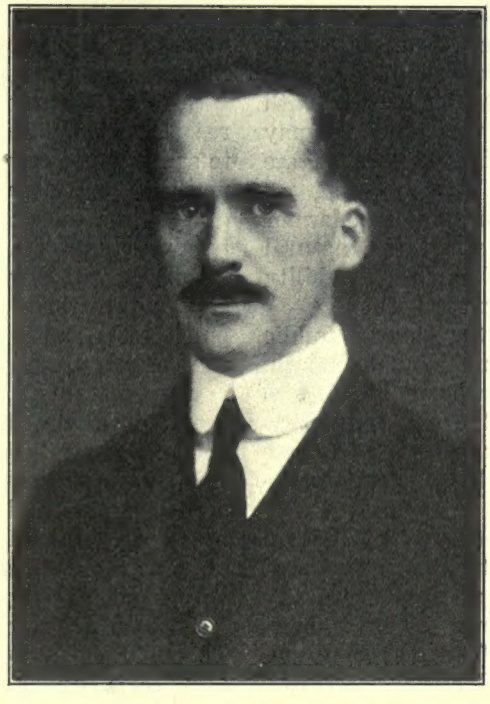
VOLUME IX JANUARY, 1925 NUMBER 1

The Road Maps of Industry

By LEONARD P. AYRES
Vice-President, Cleveland Trust Company

DIAGRAMS are the road maps of industry and business. They tell us how far we have come; they show the steep hills, long declines, and unexpected corners we have traversed to reach our present positions; and they indicate something of what we have still to do in order to arrive at our desired destinations.

A few years ago most of us were not very familiar with either road maps or business charts. We trusted to memory, or to advice picked up along the way. Frequently we consulted printed descriptions of highways as set forth in the old-time automobile bluebooks, and in much the same way we read the typewritten reports of department heads or field representatives when we wished to check up on the progress being made in the businesses with which we were identified.



Leonard P. Ayres

In recent years we have learned that in business, as in touring, the graphic representations of essential facts, as set forth in diagrams and maps, give us clearer ideas than those that we can gain from even the most carefully worded directions or reports, and they give us insight into essential relationships that cannot be secured in any other way.

It is because experience has demonstrated these advantages to the average man that both road maps and business diagrams have attained an immense vogue in the past few years. When we plan a motor trip we secure from the automobile club some long yellow cards which describe the best roads, and carry down one side simple and amazingly helpful maps which illustrate in graphic form the routes described in the printed directions. Filling stations and hotels give away hundreds of thousands of road maps every season, and in the aggregate many millions of reproductions of them are printed in the Sunday newspapers.

In a similarly impressive way, the business diagram is found in the financial pages of the papers, and in the advertising sections of almost any magazine. Banks use them; bond circulars display them; and the sales manager and business executive find them indispensable.

The reasons for this great growth in popularity are fundamentally the same in both cases, and they are the reasons that have already been suggested. Three sets of symbols are available for presenting the facts so that that they will give the desired information, and can be used for careful study. These symbols are printed words, and figures, and lines. In practice all three are usually employed together, and it is now generally realized that lines can be used to convey to the average mind ideas of relationships and proportions that are quite beyond the power of words or numbers to convey.

There is one important difference between the road map and the business diagram, and there is one characteristic of paramount importance, which they possess in common, but which is not ordinarily recognized. The difference is, of course, that the road map shows the portion of the route over which the traveler has not yet passed, as well as the part over which he has just come. The business diagram cannot do this, for part of the record may still lie in the future, and in that case the facts

which will make it up have not yet come into existence. Nevertheless, to the man who is charting the facts of his own business each day, or each week, or month, the record before him is like the map of a road over which he has just driven. It brings back to his memory in clearly defined detail each significant event and important turning point, emphasizing in his mind certain things to be avoided and others to be taken advantage of the next time he travels that way.

The characteristic of prime importance, which road maps and charts possess in common, is that those who employ them become increasingly skilled in their use, and possess in this skill a great advantage over their competitors who do not use these aids to understanding. They substitute knowledge for guesswork, records for rumors, and judgment for tradition.

Matching Production to Demand

By E. H. FISH

A GENERATION or more ago we were told that the ratio of supply to demand determined the price we had to pay for everything. If potatoes were high it was because they were scarce; if gray iron castings were high it was because more people wanted castings than there were foundries to supply them. The theory was much like some other theories—something that explained plausibly without meaning anything.

When the theory of supply and demand was advanced, it was a simple matter for anyone who wanted potatoes to raise them, or for any shop that wanted to make its own castings to throw up a shed and put in a cupola and go ahead producing. Today either venture requires experience, machinery and capital. The added complexity of doing business has made movements slow. If a shop decides today to add a foundry they hire an engineer to lay it out for them. They must study their market, secure advance contracts for supplies, material and fuel. All this, with building and equipping the plant, takes time. It may be years before the company really expects to see dividends.

The outstanding difference between these and former times is the need for greater capital, the natural timidity of capital to follow the market, and the ability of capital to carry over and hold prices high.

Against this is the inability of the general public to carry over on their end. We buy hand to mouth. This does not merely apply to our home life but to small shops and stores, and it is the one thing that makes it so very hard for a man who begins business in a small way to grow and push his way up to the top of the heap.

Here is the situation then: prices are set, not in accord with supply and demand, but by arbitrary combinations of large capital, capable of weathering any but the most severe of financial storms. There is, however, no provision for reduction of prices; they can never go any direction but up, under this procedure, unless by a terrific crash that wipes out billions of capital.

If the law of supply and demand has been permanently abrogated, what is going to happen? Must we reconcile ourselves to a steady upward turn for everything? The only solution possible involves compulsion of one kind or another. It is only under stress that prices can be held stationary or reduced. The government can, of course, carry on business at such a loss that no corporation is big enough to compete. Take, for example, the postal service. Under the government system of accounting it sometimes shows a profit, but never a real one. If the government took over the making of steel, it could do the same, but there is a limit, and that limit comes when so much private business has been federalized that the remaining private business will not stand the taxes necessary to make up the deficits. Price fixing cannot be carried out unless the price fixed allows a fair amount of profit, in which case there would be no reason for using it. Buyers' strikes can only be carried out for a short time and under great provocation.

There is just one avenue of escape possible, and that is the application of common sense. If all industries would get together to parcel out the spending money of the population, they could arrive at prices for their goods that would give them the maximum of profit for the least expenditure of energy in manufacture and selling.

Suppose that the manufacturers of phonographs and records decided that it was legitimate for the nation to spend 2 per cent of its income on their product; the machine tool manufacturers discovered that the sales of machine tools might be expected to average $1.98 per individual, etc. Then the various industries could fix prices which would assure selling their product if kept within these limits, and their business would be much safer, and on the whole more profitable. Of course, this presupposes doing business in the open. A man who wanted to start a new shop would have to show cause why he should be admitted to the circle. If in some small town there are already enough gasoline filling stations to take care of the business that exists, it is usually easy to persuade the licensing board to withhold a permit. Why not do the same on a national scale with makers of sausages and surveyors' instruments?

To a certain extent large concerns do just this thing. That is, they find out the market situation before they establish a branch shop or store. Is it not better that manufacturers and sellers should get together and match their product to the legitimate needs of the population? Why make twice as many pianos as are needed, when we know that it will cost three times as much to sell the un-needed ones as those for which there is a legitimate demand? And is not that added expense of selling great amounts of many products to buyers who are already surfeited one of the causes of the great spread between cost of materials and labor and the necessary selling price?

Generating Power at Lowest Cost

Methods of Operation at the South Philadelphia Works, Westinghouse Electric & Manufacturing Company

By P. C. EPPELSHEIMER

General Engineering Division, Westinghouse Electric and Manufacturing Company

CENTRAL power stations have grown rapidly both in number and size during the past 20 years. Transmission lines, extending out into wide areas, especially in large industrial centers, enable these stations to offer service to factories under very favorable conditions. In fact, it often happens that the cost per kw-hr. at which the central station can profitably sell current for power and light is appreciably lower than that at which it can be generated in the individual power plant of moderate or small size.

The power and lighting demands of a factory may, of course, bear such a large ratio to the present and prospective capacity of the local central station that it is either more profitable or more satisfactory to run a private plant, where full control can be exercised over operations. But the situation existing in many manufacturing plants is that power requirements can be met by local central stations at the same or just a little higher cost than that of the individual plant. Here the question arises, whether it is better to tie up a certain capital outlay in such an installation or to use this capital in production work, where it will return a much higher rate on the investment.

There is another factor to take into account, however, which is often important enough to throw the decision in favor of the private plant, even at a somewhat higher cost of power. This factor is the demand for steam throughout the plant. Steam at high pressures may be needed for testing. At lower pressures it is used in a wide variety of plants for manufacturing processes of all sorts. At still lower pressures, even down to or below atmospheric, it may be required in the fall and winter season for heating. Perhaps exhaust steam may be sold to the neighboring community for the purpose of heating offices, stores and homes.

To supply such steam at reduced pressures, engines may exhaust above atmospheric pressure, or turbines may be installed which discharge steam at stages where the existing pressure is that desired for manufacturing processes or heating. Thus, both power and heat can be got from the same steam, and most of its energy is recovered in useful form.

It is not safe to generalize on this point. Each installation must be worked out on its own merits. But the savings brought about by the correct method amount to large sums in most cases, and are well worth the time and expense involved in following the investigation down to a finish. The method of operation decided upon in the South Philadelphia works of the Westinghouse Electric and Manufacturing Company illustrates the management features involved in a particular case of this kind.

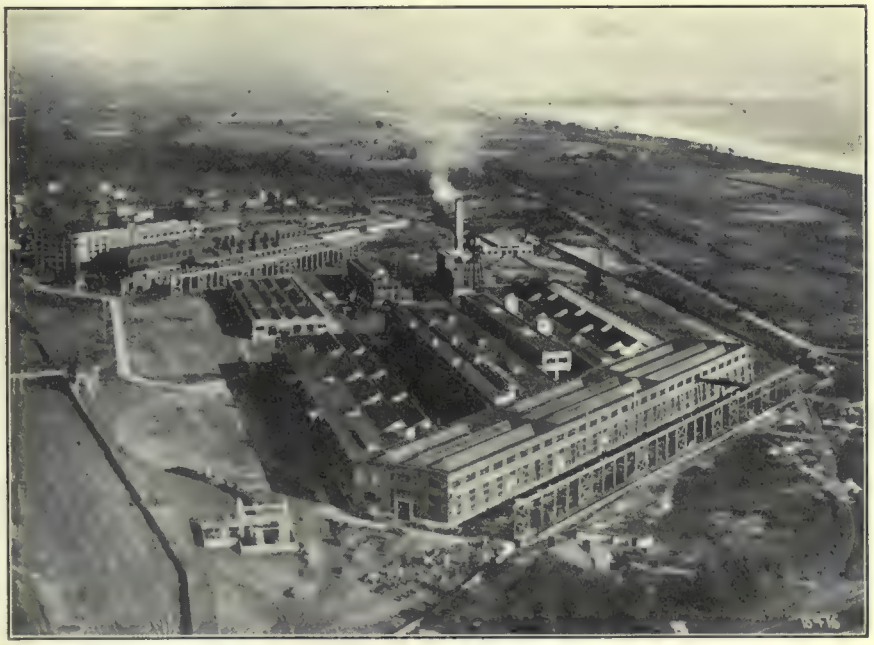


FIG. 1 AIRPLANE VIEW OF THE WESTINGHOUSE PLANT AT SOUTH PHILADELPHIA

The power plant at the South Philadelphia works is in a separate building, situated approximately in the center of the surrounding shops. It serves a fourfold purpose, namely, to furnish power for shop machinery, light and heat for shops and offices, and high-pressure steam to test floors, forging presses, etc. Fig. 1 shows an airplane view of the plant and Fig. 2 is a layout to scale, of the buildings, yard, railroad connections and other features of the property.

During the winter months all the buildings must be heated, requiring large quantities of steam at pressures of from 2 to 4 lb. This steam can be produced most economically by generating it at high pressure and passing it through non-condensing turbines operating at the required pressure, and for this reason that type of turbine was installed. From April 1 to

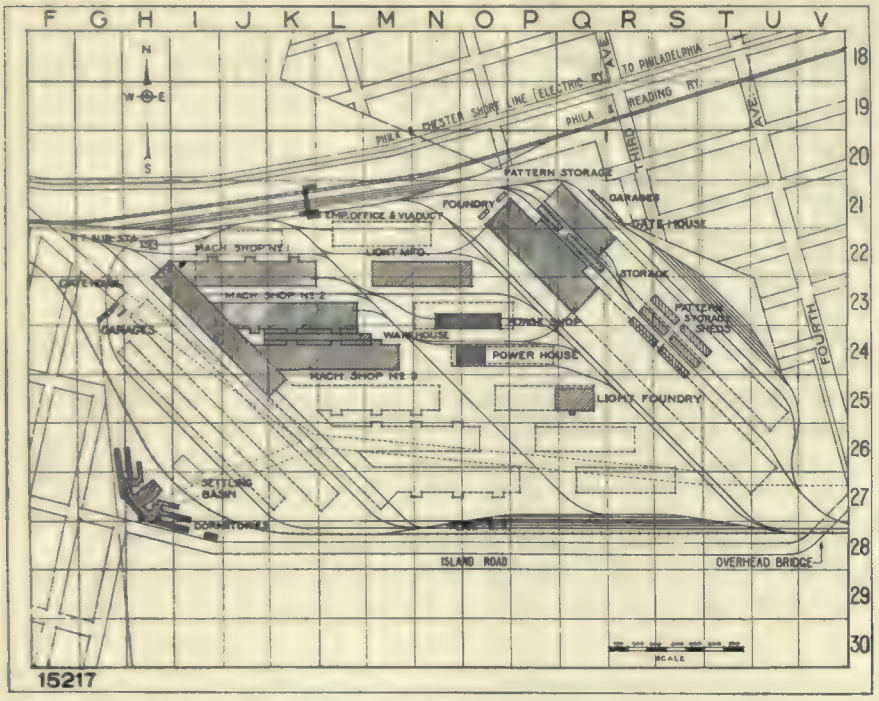


FIG. 2 LAYOUT OF THE SOUTH PHILADELPHIA WORKS

October 1, when the heating system is not needed, the turbines are shut down, light and power being purchased from the local power company. This arrangement is advantageous to both parties concerned, as it is during the summer months that the local power company experiences less demand from other sources. It has the additional advantage of a reserve source of power available at all times to take care of emergencies.

There is a further mutual arrangement between the Westinghouse power plant and the local central station. At times when some emergency has been experienced by the central station, all of the surplus current from the Westinghouse plant is delivered to the lines of the local company, enabling it to keep up its service without inconvenience to other customers. Hence the two systems have supplemented each other at an all-round economic advantage.

The boiler-room of the Westinghouse plant, Fig. 3, contains 6 Stirling boilers, placed back to back in two rows of three each, making the fire aisles toward the outside of the building. Each of these boilers has a 625-hp. rating with 6230 sq. ft. of heating surface. They generate steam at 225 lb. pressure and are equipped with superheaters capable of giving a total steam temperature of 550 deg. at 150 per cent boiler rating.

All boilers discharge their gases into a common brick stack 190 ft. high, 16 ft. inside diameter at base and 13 ft. at top.

Westinghouse underfeed-type stokers are used, driven by a continuous shaft across the front of each trio of boilers. On one side of the boiler-room this shaft is driven by a Westinghouse stoker engine at each end, one of which is kept as a spare. On the other side of the room a geared turbine replaces one of the engines and is at present in operation.

A large open air space of ample capacity is maintained at the side of the power house for the storage of coal. Alongside the wall, a railroad siding is provided whereby coal may be either unloaded into the storage by locomotive crane or dumped from the bottom of the cars into a hopper leading to the basement. There it passes through a Beaumont tooth-type crusher, from which it is conveyed to the bunkers at the top of the building by a chain and bucket elevator and distributing belt. Swinging ducts deliver the coal from the bunkers to the furnace hoppers.

Ashes are removed from the basement by means of a steam ash ejector and delivered by this ejector to an elevated concrete ash bunker, from which they are chuted to railway cars for dumping.

Three boiler feed pumps are provided. Two of them are of the three-stage centrifugal type of 400-gal. capacity each, and capable of pumping against a 580-ft. head. The other, used as a spare, is also a centrifugal pump, but of 850-gal. capacity and capable of working against the same head as the two smaller ones. Each of the three pumps is driven by a single-wheel Westinghouse turbine.

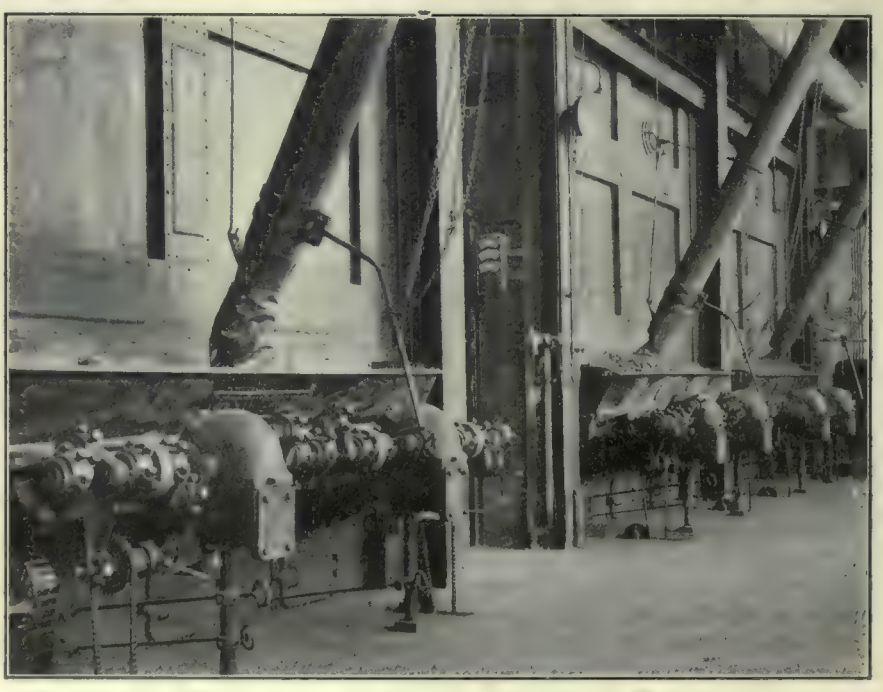


FIG. 3 FIRE AISLE AND STOKERS OF ONE BANK OF BOILERS

Other auxiliaries are turbo-blowers, two 700-gal. reciprocating service pumps, one Westinghouse 2000-gal. turbine-driven service pump, and one 1500-gal. Worthington fire pump.

The Delaware River furnishes the boiler make-up water, which is heated to approximately 212 deg. in an open heater by means of exhaust steam from the auxiliaries.

In the turbine room, which is shown in Fig. 4, practically all apparatus is of Westinghouse design and manufacture.

The main turbine installation consists of three 1560-kva., three-phase, 60-cycle, 6600-volt, 3600-r.p.m., non-condensing, reaction turbo-generator sets. No condensing equipment is provided in the power plant. The excitation for the generators is furnished by two 35-kw. exciters, one turbine-driven and the other driven by a 440-volt, three-phase, 60-cycle induction motor.

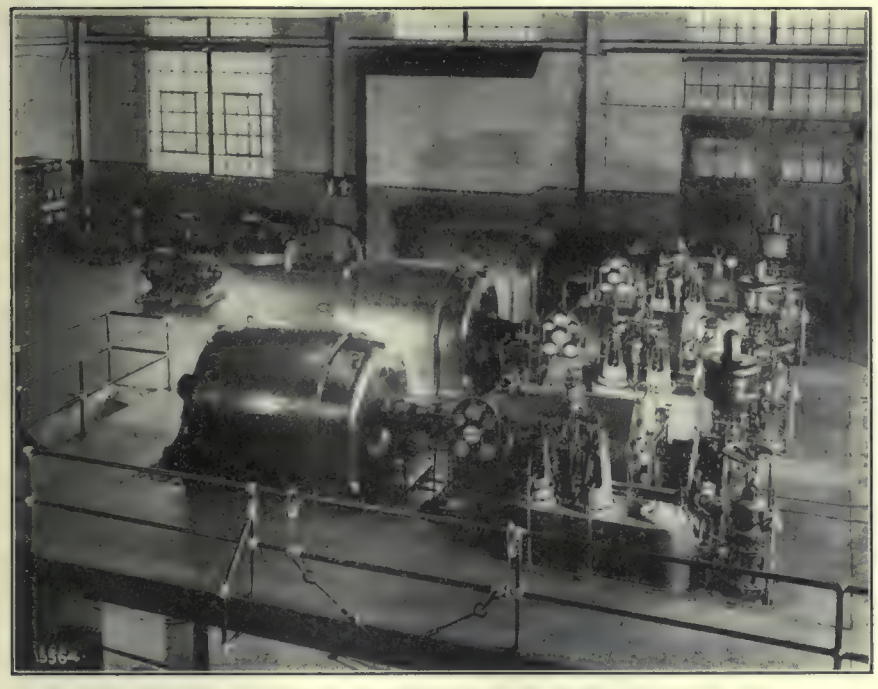


FIG. 4 VIEW IN TURBINE ROOM

Owing to the fairly large area covered by the works, it was decided to generate power at 6600 volts, three phase, 60 cycles, and to distribute at this voltage by underground cables to various substations located about the works. Three substations contain step-down transformers from 6600 to 440 volts for all constant speed motors used for driving machine tools, compressors, elevators, etc. The compressors are driven by synchronous motors in order to utilize their power factor correcting ability. Rotary converters are located in each substation to supply direct current at 250 volts for operating cranes, variable speed machine tools, and variable speed blowers for the cupola furnaces. These converters operate at approximately 100 per cent power factor and, with the assistance of the synchronous motors, will tend to counteract the rather low power factor which is produced by the large number of induction motors operating the constant speed machine tools and elevators.

The main and auxiliary switchboards are located on the same floor as the turbines. The bus bars, oil switches and disconnecting switches are located in the basement directly below. A separate room has been built back of the switchboard over the reactance coil chamber to install transformers and rotary converters for a substation to provide alternating and direct current power and lighting for the power plant itself and nearby buildings. All outgoing feeders are equipped with single-phase reactance coils to insure continuity of operation in case of short circuit on any of the feeder circuits. These feeders are carried to distributing vaults at the corner of the building, from which they are led to the underground duct system.

An 80-ampere hr. electric storage battery is located in the room back of the switchboard to insure its operation at all times. This battery is kept charged by a small motor generator set.

The lighting system is entirely separate from the power system. Separate lighting transformers are installed at each substation, which reduce the voltage from 6600 to 440, and three-phase lighting mains are carried through the works at 440 volts. The lighting transformers are located on the outside walls of the buildings at various points, to supply the lighting circuits which operate at 110 volts. High efficiency tungsten lamps are used exclusively for the general illumination, the sizes varying from 40 to 400 watts.

Steam for the shop and office heating system is obtained at 10 lb. pressure from the exhaust of the main turbine units and is piped to the various distributing points through underground tunnels.

The offices are heated by steam radiators with a total heating surface of approximately 100,000 sq. ft. The radiators are arranged for the condensate to be returned to the boiler-room by means of a vacuum system.

The shops are heated and ventilated by an indirect blower system. Each shop is equipped with two large blowers which draw cool air over heated coils and deliver it to all portions of the building through warm air ducts. These blowers have sufficient capacity to change all the air in the shop once an hour. The condensate from the heating coils is delivered back to the power house in the same manner as that of the radiators. In case of a shutdown of the turbo-generators in winter, the system is equipped to take steam from the boilers reduced to 75 lb. The total heating surface for the blower system is approximately 52,000 sq. ft. In summer these same blowers are employed to circulate cool air.

Besides the low pressure steam pipe the tunnels also carry the high pressure pipes for test floors and presses, etc. A 10-in. pipe leads from the boiler-room to the main test floor, from which branches are taken

for the forge shop, light machine shop test floor, pump test floor, etc. Due to the long carry from the power house to the main test floor, there is a 25-lb. drop in pressure, the best steam pressure obtained at the test floor being about 200 lb.

In summer the boilers are run merely to supply steam to the test floor and forge shop. One or two boilers under steam furnish a quantity sufficient for the purpose.

The ratio of test load to power and light load is small, so that, although steam is required in summer, it does not pay to run the turbines. As soon as the lighting load increases with the approach of fall, and especially when the need for heat develops, however, the situation changes. The volume of steam required for heating is such that, with but little additional expense, it can be produced at a pressure and temperature sufficient to run the turbines and auxiliaries and carry the power and lighting load at a figure well below the cost of purchased current.

Work of the Division of Simplified Practice

SERVICE by Government to American Industries" is well illustrated by the steadily growing demand from all branches of business for the services of the Division of Simplified Practice of the Department of Commerce. This division, established by Secretary Hoover early in 1921, serves as a centralizing agency in bringing together producers, distributors and consumers, when so requested by any of these groups, for the purpose of assisting these interests in their mutual efforts to eliminate waste in production and distribution.

The American standard of living is the product of high wages to producers and low costs to consumers. The prosperity of American industry is the product of well-paid workmen, volume business, skillful management, and fair returns to those who have their money invested in our enterprises.

Reduction in Sizes and Dimensions

Recognition of this fundamental economic service is evidenced by the co-operative action of many groups—aided by the Division of Simplified Practice—in the elimination of superfluous and unnecessary varieties in sizes and dimensions of commonly used commodities. The accumulation of excessive stocks of little used, or seldom called for, sizes, the consequent tying up of investment, the slowing down of turnover, are all drags or brakes on industry and commerce, and therefore as avoidable economic wastes.

To date, simplified practice, or the elimination of wasteful variety, has been successfully applied in many fields. Paving bricks have been reduced from 66 to 5 varieties; beds, mattresses and springs from 78 to 4; metal lath from 125 to 24; asphalt (grades) from 88 to 9; hotel chinaware from over 700 sizes to 160; files and rasps from 1351 to 496; rough face brick from 39 sizes to 1; common brick from 44 to 1; range boilers 130 to 13; woven wire fencing from 552 to 69 varieties; milk bottles from 49 to 9; milk bottle caps 29 to 1; bed blanket sizes 78 to 12; hollow building tile 36 to 19; roofing slate sizes from 60 to 30; forged tools from 665 to 351; blackboard slate sizes from 141 to 14; asbestos paper widths from 3 to 1, and weights 8 to 5; asbestos millboard sizes 3 to 1, and thicknesses 7 to 4; brass lavatory and sink traps 1114 to 72; bolts and nuts for farm machinery from 1500 to 840; hospital bed sizes from 33 different lengths, and 34 different widths, and 44 different heights to 1 standard length, 1 standard width and 1 standard height; hot water storage tanks from 120 to 14; cotton duck widths and weights from 432 to 83; steel reinforcing bars 40 to 11.

Catalogued items of builders' hardware have been reduced 26 per cent; varieties of steel barrels and drums 60 per cent; varieties in warehouse forms 95 per cent. Standard nomenclature, grades and sizes for softwood lumber have been established. Similar effort is under way in hardwood.

Simplification of automotive parts; gas water heaters; steam boiler parts and fittings; hacksaw blades; pocket knives; shot gun shells; drills; reamers; mill cutters; taps and dies; steel lockers; shovels; furnace parts; sash, doors and millwork; and nearly a hundred other commodities, is being developed by those engaged in their manufacture, sale and use. The Department of Commerce is co-operating in all these projects. In the three years of its operation, members of the Division of Simplified Practice have, at the request of the industries interested, held over 100 simplification conferences, made over 200 formal addresses on the subject, and participated in nearly 200 other meetings where attention was given to simplification as a waste-elimination measure.

Advantages of Simplification

The testimony of leaders in these several fields of endeavor is that simplification decreases stocks, production costs and selling expenses, while stimulating turnover, increasing volume and strengthening employment. Estimated annual savings range from a half million dollars in one commodity field to a quarter of a billion dollars in another. These savings eventually find their way back to the consumer either in lower prices, better quality, or both. Hundreds of American citizens, including labor leaders, merchants, manufacturers, engineers, architects, contractors, bankers, educators, economists, and editors, have commended the Department for the assistance it is rendering in the present nation-wide effort to squeeze all avoidable wastes out of American business, to the end that our industrial stability, our commercial supremacy, and our national prosperity will be maintained, and our standard of living advanced. A nation can perform no greater service than to advance the living standards of its people.

Forecasting Your Industry's Cycle

Industrial Budget Methods—IV

By JOSEPH H. BARBER

Staff Assistant to the President, Walworth Manufacturing Company

LET us take stock of our progress. Article I of this series[1] first stressed the need for comparing like with like—orders with orders, quantities with quantities, and so forth. Then it emphasized the necessity of reducing the cycles of an individual industry to common-denominator terms in order to compare its movements with those of external economic conditions and to establish its policies and operation upon sound economic fact. The second and third articles of the series[2] presented methods for finding an industry's own cycle and analyzed the movements of specific external economic cycles which might be brought to bear upon and even to explain the individual industry's cycle.

The third article also implied that the variations in general business, as reflected in figures published on the financial pages of daily papers, will never yield an administrator tangible guidance in controlling his own business until he can translate them into the language of his own business. Likewise, the "general business" forecasts of many agencies can be no more specific in aiding him in his general control than are "general purpose" price indexes in setting his prices, until he can reduce their meaning to policy recommendations, applicable in the solution of his problems.

Our next task, then, is to tie up some specific external cycle curves with an industry's specific cycle in order to explain why the industry's cycle acts the way it does; to study the relative actions between the cycles compared; and to provide a basis for forecasting quantitatively the industry's cycle.

Again, we shall select a particular cycle as a typical "case," and shall carry its solution through step by step. Table 9, then, shows the cycle of Walworth "X" product orders received in physical quantities—an actual history. The figures are developed by the methods of Article II. Moreover, when we refer to "cycles" in this present article, we shall habitually assume that "seasonal" and "long-time growth" influences have been eliminated from the actual historical figures and that comparisons are of the remaining cycle (and erratic) movements only.

The essence of all statistics is comparison—relevant comparison, as of cause with effect. Therefore, since in Table 9 we have an index of the cycle variations of a specific industry's physical volume of trade, what would be more natural than to compare it with Carl Snyder's index of the average volume of trade?

This is done in Fig. 28. But how violent the swings of the cycle variations of a specific industry's physical volume of trade are, as compared with the swings of his index! In the first article of this series we were careful to state, and now we do well to restate, this caution:

> The writer has listened to the insistence of one author that 60 per cent of the fluctuations in an industry are caused by external economic factors. His confidence in the result of such business cycle analysis has, however, been restrained by the fact that, to prove their points, most of the business cycle theorists have selected data of very wide fluctuations; and that that data, selected because it is "sensitive," should be labeled—"pertains to certain distinct types of production or distribution only. Not a typical sample of industry!"
>
> This fact deserves recognition. On the other hand, the author of this series is himself associated with an industry that is of the type having violent fluctuations, or cycles, not easily anticipated. The series is, therefore, written for those who face similar fluctuations as a matter of known fact, and who would achieve a solution to a very real problem, common to many industries.

TABLE 9. PRODUCT "X" ORDER CYCLE—IN PERCENTAGE OF VARIATION FROM NORMAL

	1919 Per Cent	1920 Per Cent	1921 Per Cent	1922 Per Cent	1923 Per Cent	1924 Per Cent
January	− 66	+ 177	− 72	− 40	+ 95	+ 49
February	− 57	+ 122	− 68	− 27	+ 118	+ 68
March	− 34	+ 31	− 70	− 14	+ 94	+ 26
April	− 15	+ 11	− 70	+ 13	+ 51	− 10
May	+ 12	− 2	− 75	+ 21	+ 20	− 30
June	+ 51	+ 21	− 75	+ 18	− 16	− 29
July	+ 100	+ 13	− 72	+ 12	− 28	− 27
August	+ 93	− 16	− 62	+ 3	− 24	− 19
September	+ 80	− 33	− 43	− 4	− 26	− 12
October	+ 77	− 43	− 42	− 4	− 34	.....
November	+ 156	− 57	− 44	− 5	− 38	.....
December	+ 201	− 64	− 51	+ 53	+ 9	.....

So here we are with a specific cycle—an actual fact in our business. It needs explanation. It should be so adjusted and compared with some related external cycle as to provide a basis for forecasting.

Developing a Related External Cycle

Close analysis of Fig. 28 shows that turning points in our particular cycle, in point of time only, prove to coincide with, or a little while after, the turning points in the average volume of trade cycle. But our cycle swings through such wide arcs that it gives no basis for anticipating the *extent* of upswing or downswing in our cycle after it has turned.

According to the logic of our earlier discussions, we should be able to find some particular, more closely

[1] See MANAGEMENT AND ADMINISTRATION, October 1924, p. 371.
[2] See MANAGEMENT AND ADMINISTRATION, November and December 1924, pp. 479 and 589, respectively.

related, external cycles that would explain the great violence of our product X cycle. Therefore, we must search. To be eligible, any cycle must be based upon monthly figures, preferably covering the full span of years since 1919. These monthly figures must relate to orders, permits granted, bookings, or the like, because our cycle is of orders. For like reasons the record must be in terms of physical quantities.

"The Survey of Current Business"[3] is our primary source—but this is not the place to catalog all possible sources.[4] It is sufficient to say that we have not yet found a dearth of figures that might be used. The test is always to select a set of figures destined to yield worth-while findings upon analysis. We have already set up a clear specification.

Finally, we gather and develop the cycles of the orders, bookings, permits, and so forth, of the series listed in Table 10. All these cycles are closely related to the product X order cycle, in the sense that the demand for the X line of product (a group of some 400 items in all) arises from the fields of activity represented. As Table 10 shows, and as would be expected in consequence of their relation, closer to our cycle than is the relation of Carl Snyder's average cycle, the relative violence of these selected external cycles approaches the violence of our product X cycle.

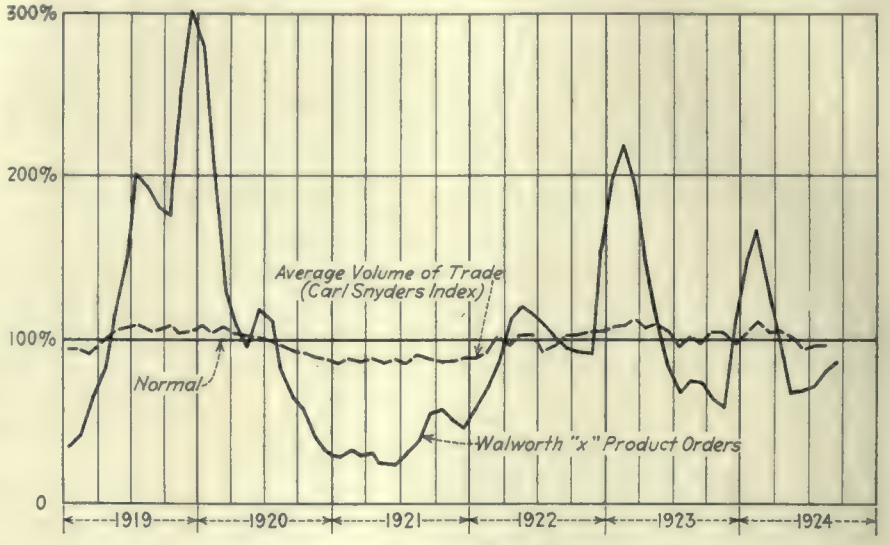


FIG. 28 RELATIVE EXTENT OF CYCLE SWINGS MEASURED IN PERCENTAGE VARIATION FROM NORMAL

Reducing Cycles to a Comparable Basis

However, what we want to study is not the relative violence of the several cycles that may relate themselves to ours. We want some method for comparing their *relative* similarities, so that we may study those cycles that lead or lag in their relative movements. We still have a problem of reducing the cycles to a true common denominator of comparison, for some curves that swing through a limited range, as Carl Snyder's index does, are quite as significant as those that swing through wider arcs during a short, intense period.

If we grant this to be true, then to place *equally significant* movements on an equitable basis of comparison, we must expand the moderate movements of some of the cycles, and contract those of others, until each cycle appears to swing through arcs of approximately equal size. This is done by showing each cycle in terms of its own "cycle unit." The process may be described as measuring each cycle in terms of its own yardstick.

In other words, in our forecasting comparisons, the quantity of fluctuation does not so much concern us. Obviously, our standard quantity of fluctuation (our "yardstick") will be as significant to us as their standard quantity (their "yardstick") will be to those facing more or less severe fluctuations in some other industry. But whether our yardstick or theirs is large or small is not significant for our present purpose. Therefore, disregarding the size of the yardsticks themselves, but measuring each cycle in terms of its own yardstick, comparison of several cycles may then be upon a true "common-denominator" basis. Whereupon we may interpret, in terms of our industry, the significance of the fluctuations of the other related industries upon which ours depends.

The size of the yardstick, or "cycle unit," for our Table 9 cycle is calculated in Table 11. The resulting cycle expressed in terms of these cycle units is shown in Table 12 and Fig. 29. This figure shows the wide fluctuations of X product orders moderated. Now, if Carl Snyder's index were measured in terms of *its* cycle unit, the effect would be to expand its fluctuations to a size approximately equal to those of Fig. 29.

TABLE 10. CONTRASTING DIFFERENCES IN SIZE OF CYCLE SWINGS OF CERTAIN SELECTED INDIVIDUAL CYCLES*

The usual violence of boom and depression of these cycles is compared with the usual violence of boom and depression in the average volume of trade as exhibited in Fig. 28.† Carl Snyder's index there shows that booms and depressions tend to swing at extremes about 10 per cent either side of normal. Compare this usual degree of violence in the grand average volume of all trade with the following:

Oil Rigs and Drillings	over	4	times as violent	
Total Building, Western States	"	5	"	"
Fire Brick Orders	"	6½	"	"
Structural Steel Sales	"	6½	"	"
Sanitary Ware Orders	"	7½	"	"
Machine Tool Orders	"	10½	"	"
Industrial Building, Western States	"	11½	"	"
Merchant Pig Iron Orders	"	12	"	"
Walworth Total Orders	"	8	"	"
Walworth "X" Product Orders	"	10	"	"

* Sources: Oil rigs from *Standard Daily Trade Service;* western states total and industrial building from F. W. Dodge Corporation; fire brick orders from Refractories Manufacturers' Association; steel sales, sanitary ware orders and pig iron orders from *Survey of Current Business;* machine tool orders from National Machine Tool Builders' Association.

† These comparisons are based upon the relation between the size of the several individual cycles' cycle units.

[3] Issued monthly for the government by the Superintendent of Documents, Washington, D. C., $1.50 per year. A veritable mine of pertinent monthly data, always currently brought up to date.

[4] "The Source Book of Research Data," edited by Lewis H. Haney, is devoted entirely to sources of reliable statistical information.

TABLE 11. CALCULATION OF CYCLE IN CYCLE UNITS OF VARIATION FROM NORMAL

(Cycle unit calculations for all cycles compared must be calculated upon the same combination of years—e.g., as here, 1919 to 1923.)

		Percentage Variations From Normal (From Table 9) (A)	"Squares" of Column A Values (From "Management's Handbook" p. 23) (B)	Variations From Normal in Cycle Units (Column A Values divided by Amount of Cycle Unit* (C)
1919	January	− 66	4,356	− 1.00
	February	− 57	3,249	− 0.86
	March	− 34	1,156	− 0.52
	April	etc.	etc.	etc.
	May	etc.	etc.	etc.
1923	October	etc.	etc.	etc.
	November	− 38	1,444	− 0.58
	December	+ 9	81	+ 0.14
Total of 60 Squares			260,167	
Average Square = 260,167 / 60			4,337	
Amount of Cycle Unit*			65.9%	

* This "amount" of cycle unit is the "square root" of the "average square" shown in the next to last line of the table in column B. This square root is read out of the square root column of the tables beginning on page 23 of "Management's Handbook."

The *significance* of the cycle movements of both indexes would then be truly comparable.

The next step is to post upon Fig. 29 the cycles of the industries which yield us orders for our X product. For chart simplicity, a distinguishing letter is assigned to identify each cycle and that letter only is plotted in each month's column at the proper height above or below normal. Thus Fig. 29 becomes a frequency chart with a lot of letters, clustered about the product X cycle line. On this chart, if the letters be traced through, it will appear that all cycles swing about equal distances above and then below normal, although their turning points or varying levels may occur at different times.

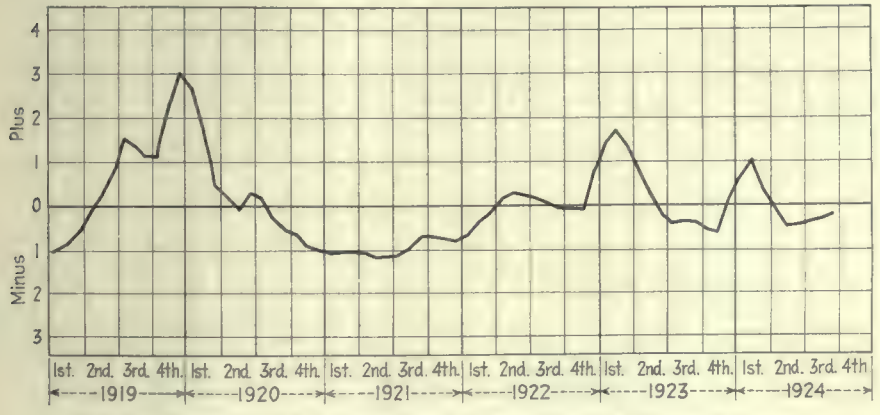


FIG. 29 PRODUCT "X" ORDER CYCLE MODERATED BY BEING PLOTTED IN CYCLE UNITS

Reading the Cycle Mass Movements

However, the plotting of the mass of letters is not intended for the tracing through of particular cycles. In fact, it is essential for the moment to forget the detail and see the movement of the mass. In mid-1919, the "scatter" had been reduced to a narrow range. Business was only at normal—but all were sharing about alike at that fair level.

After nine months, prosperity had come—but it had not come alike to all. The "scatter" was over a relatively wide area. This is an unhealthy condition even though all the industries may be receiving orders at above-normal rates. It is a condition which always precedes and forecasts a downward mass movement.

Such a downward movement continues until approximate balance is restored. In 1921, business had collapsed to sub-normal levels before the scatter had been reduced to the narrow range that suggested that industries were sharing and sharing alike—even if it were a sharing of adversity. Nevertheless, the re-established balance assured a permanent recovery. In the years since 1921, now and then the balance has been restored, and continued good business assured, before all industries had sagged to such low levels.

Comparing Cycle Averages

So much for emphasis of the mass movement. Now we can talk of averages and realize that they do not tell the whole story. Table 13 calculates the straight average of all the external cycles considered. When the average cycle is added upon Fig. 29, the cycle line each month splits about evenly the month's area created by the letters representing the external cycles. Space does not permit showing a cut of this final condition of Fig. 29, but Fig. 32 (to be referred to later in another connection) nevertheless may be referred to here to show how surprisingly close—by accident, in one sense—the average demand cycle (dotted line) compares with product X's cycle.

However, we should give some consideration to the question as to whether the movements of some one of the external cycles may be relatively more important than some other in determining the movement of our own cycle. The eye then spots out from the mass those particular cycles which apparently influence the average cycle *toward* our own order line.

Fig. 30 shows what the eye really sees when analyzing Fig. 29 after Fig. 29 has been posted with all the letters and the dotted line. Instead of attempting to grasp the graphic detail, the eye first notes "areas of error" where the average cycle line varies from the product X cycle line. Then it sees a string of letters conspicuously prominent on the *same side of the average line* as the area. Then, mentally, or even objectively as in Table 14, the conspicuous cycle is checked up to see whether allowing it extra influence in the average would improve the fit of the average against product X's cycle.

Furthermore, when this table is compared with the checking tables for two other cycles—of pig iron orders and of sanitary ware—it is observed that their best influences ($\surd$'s) occur during those quarters when

TABLE 12. PRODUCT "X" ORDER CYCLE—VARIATION FROM NORMAL, SHOWN IN CYCLE UNITS*

	1919	1920	1921	1922	1923	1924
January	− 1.00	+ 2.69	− 1.09	− 0.61	+ 1.44	+ 0.74
February	− 0.86	+ 1.85	− 1.03	− 0.41	+ 1.79	+ 1.03
March	− 0.52	+ 0.47	− 1.06	− 0.21	+ 1.43	+ 0.39
April	− 0.23	+ 0.17	− 1.06	+ 0.20	+ 0.77	− 0.15
May	+ 0.18	− 0.03	− 1.14	+ 0.32	+ 0.30	− 0.46
June	+ 0.77	+ 0.32	− 1.14	+ 0.27	− 0.24	− 0.44
July	+ 1.52	+ 0.20	− 1.09	+ 0.18	− 0.43	− 0.41
August	+ 1.41	− 0.24	− 0.94	+ 0.05	− 0.36	− 0.29
September	+ 1.21	− 0.50	− 0.65	− 0.06	− 0.39	− 0.18
October	+ 1.17	− 0.65	− 0.64	− 0.06	− 0.52	.....
November	+ 2.37	− 0.87	− 0.67	− 0.08	− 0.58	.....
December	+ 3.05	− 0.97	− 0.77	+ 0.80	+ 0.14	.....

* The values in this table are derived by dividing each corresponding value of Table 9 by a constant amount, 65.9 per cent, which is the amount of the "cycle unit" for this particular cycle. For calculation of its amount, see Table 11.

"disadvantages" (X's) are set up in Table 14. In other words, the advantages to be gained, per this table, can be retained, while its disadvantages will be offset by adjusting the influence allowed to certain other cycles.

Weighting the Average Cycle

Of course, this sort of check-up table is sometimes used negatively. The eye may spot some string of letters conspicuously outside of the general mass movement of all the cycles, but on the opposite side of the average line from the "area of error". In this case, to give that cycle *less* influence would reduce the area and make the fit closer. In this particular example, no cycles are given lesser weighting, but the check-up tables suggest giving an extra weight not only to the industrial building cycle, but also to the pig iron order and the sanitary ware order cycles.

Based upon these conclusions either mentally or graphically established, the original, unweighted average cycle is recalculated to derive a weighted average cycle. The process is simple. All the Table 12 total and average values are crossed out. Then new totals are inserted over the old ones. In adding up the new totals in each column, the values for each of the three important cycles are added in twice, while the values for each of the other cycles are added in but once. Then, to get the new averages, of course, each of the new totals must be divided by 12. In Fig. 31, the resulting, improved, weighted average demand cycle is shown against the original Fig. 29 product X order cycle.

The Value of the Average Demand Cycle Line

The usual questions asked, when we have explained the process up to this point, are: "What good is such an 'average demand' cycle line after you have it? If it doesn't run ahead of your own cycle, and if you can post the figures of your own product cycle before you can get the current data for the average demand cycle, how does it help?"

In the introductory article of the series, it was admitted that we of the Walworth Company are handicapped in our attempts at forecasting. We are *manufacturers*. For effective control we must produce against *orders received*. For production purposes, we must furnish estimates in familiar *quantity* terms. Now, *all* these, by our early analysis, are the first to register cycle changes. This present analysis has shown that even such early cycle indicators as Carl Snyder's index of trade, building contracts awarded, pig iron ordering, and so forth, do not change ahead of our own changes.

TABLE 13. CALCULATION OF AVERAGE DEMAND CYCLE
(Straight average of 9 individual cycles, each expressed in number of cycle units variation from normal.)

Cycles Representative of Changes in Demand for Walworth "X" Product	1919 Jan.	Feb.	Mar.	Apr.
Average Volume of Trade (Carl Snyder's)	− 0.63	− 0.63	− 0.94	etc.
Merchant Pig Iron Orders	− 0.89	− 1.08	− 0.98	etc.
Structural Steel Sales	− 1.65	− 1.67	− 1.67	etc.
Total Building, Western States	− 1.97	− 0.03	− 1.45	etc.
Industrial Building, Western States	− 0.85	− 0.83	− 0.62	etc.
Oil Rigs and Drillings	− 0.73	− 0.77	− 0.69	etc.
Fire Brick Orders	− 1.66	− 1.66	− 0.61	etc.
Sanitary Ware Orders	− 1.36	− 0.87	− 0.82	etc.
Machine Tool Orders	+ 1.71	+ 1.29	+ 1.39	etc.
Net Total	− 8.03	− 6.25	− 6.39	etc.
Average Demand Cycle = Total / 9	− 0.89	− 0.68	− 0.71	etc.

The answer to the questions is this: Just to derive an average cycle for present comparison only, would be little more than effort wasted in idle amusement. It is true, we do recognize that our product X's fortunes, its fluctuations through such wide arcs of changing volumes, must be dependent upon external economic conditions. We do appreciate that our own product X order cycle itself is an excellent and a true barometer of general business cycles, because it is itself an average, a composite, a net effect of external economic cycles and hence well reflects outside influences.

But here is the point. We cannot pick our own order cycle apart. From it alone we cannot get at causes. No grand average cycle can explain the causes of its own variation. Article III[5] went so far as

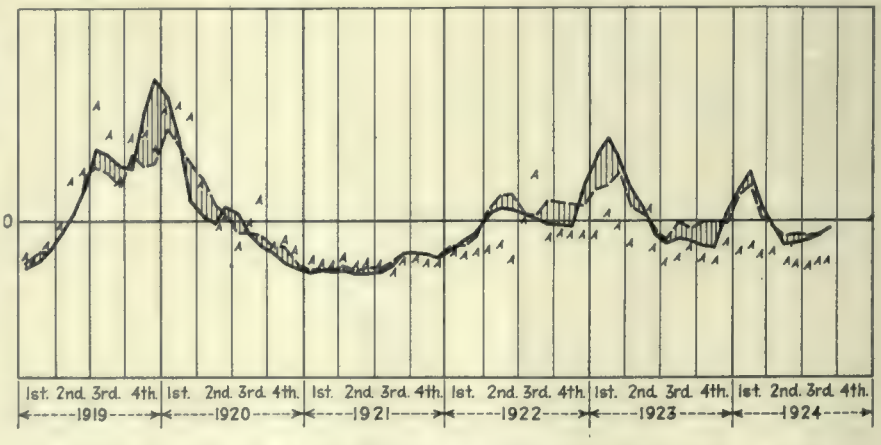


FIG. 30 HOW THE EYE SEES CYCLE A'S INFLUENCE UPON THE AVERAGE DEMAND CYCLE

[5] See MANAGEMENT AND ADMINISTRATION, December 1924, p. 589.

to say that even so-called general business cannot be comprehended adequately unless we note the interplay of many inter-related individual cycles of business.

That principle is simply extended to apply here in the analysis of product X's cycle. We cannot comprehend the X cycle changes until we get at the changes in the cycles of demand that cause X cycle's changes. But now we can pick apart its net effect. We can pick apart our net average cycle. We can "resolve its forces" into elements for separate study.

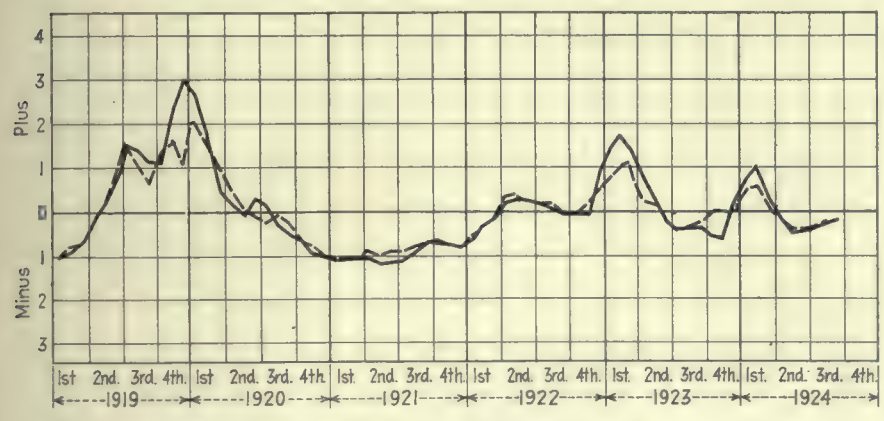


FIG. 31 ADJUSTED (WEIGHTED) AVERAGE DEMAND CYCLE AGAINST PRODUCT "X" ORDER CYCLE

And when we do so we find opened up a fertile field, rich in forecasting possibilities.

Reading the Average Demand Cycle

Fig. 32 shows the structural steel sales cycle compared with total United States building contracts awarded. It is clear that the sales cycle moves up and down with, or a little after, the contracts cycle and that they correspond well in the relative extent of their cycle movements. Economically, they should react just that way. But the vital finding is not that the building contracts cycle may turn ahead of the steel sales cycle. The greatest value attaches to the fact that we have traced from an effect back to its cause. Steel sales cycles are caused by building cycles. And concerning building cycles there is always a vast fund of current information and much economic discussion as to their movements in the immediate future. In fact, there is one "forecasting service" which specializes on the building situation alone.

So, for each of the factors separately, there is some national magazine, some forecasting agency, or some special data we have gathered that provides us an economic basis for answering the questions: What will be the trend of structural steel sales during the coming year? What are likely to be the changes in pig iron ordering rates? And so forth.

When we prepare a forecast of the X product cycle, we must tangibly summarize the current prospects for each of the cycles which are elements of the average demand cycle. Objectively, for each cycle on its separate chart, we must draw forward *some* cycle line, some incline or peak, some decline or valley, to represent our anticipation of its probable movements. Each of these cycle curves, projected into the future, may imitate some precedent cycle at some time in its own history when conditions were similar to those now anticipated for the following year. If there be no sure precedent, or if there is now reason to think there should be an exception to the reactions established by precedent, then the course drawn forward for the cycle will represent current judgment as to the immediate outcome of developing economic conditions.

Difficult, you say? Is it not hazardous to attempt forecasts of cycles that run with or ahead of the stock market cycles?

Of course there is risk. But the assumption of risk is the very essence of enterprise. Production must be undertaken against future requirements. Somebody must guess an answer to the question: "How much?" It is management's job to hazard an answer. It cannot be left to the balance-of-stores clerk, who lacks a wide outlook and who can but hastily scan a bewildering detail of immediate past history. In our type of business, this recent past experience is anything but the best guide as to the probable immediate future.

Therefore, some line is projected into the future to represent the anticipated cycle course of each element of our "average demand cycle". The monthly values are read off and a table, after the style of Table 13, gives us at the bottom a month-by-month forecast of our average demand.

If, then, we plot forward the average demand cycle

TABLE 14. CHECKING UP AN INDIVIDUAL DEMAND CYCLE'S INFLUENCE UPON THE AVERAGE

(e.g. Total Industrial Building)

√ Indicates that, if the industrial building cycle were given greater influence, it would make the average demand cycle closer to our order line.
X Indicates that it would make the average further away.
O Indicates that extra weight would have essentially no effect (because the industrial building cycle is essentially at the present average level).

		1919	1920	1921	1922	1923	1924	Summary √	Summary X
By Quarters	1st Quarter....	O	√	O	X	X	X	1	3
	2nd Quarter....	X	√	O	√	X	√	3	2
	3rd Quarter....	√	O	O	√	√	.....	3	.....
	4th Quarter....	√	O	O	√	√	.....	3	.....
Summary*	√	2	2		3	2	1	10	.....
	X	1			1	2	1	.....	5

* The horizontal summary shows that in most cases the greatest advantage is gained in the quarters that most need improvement.
The table's summary lines and columns show that the disadvantages to be faced are not all concentrated at any one place in the space of time.
Therefore, since advantages gained outweigh disadvantages faced; since advantages all concentrate where most needed; and since the disadvantages are widely spread over the whole period, the average demand cycle will fit the order line still closer, if extra influence is given to this individual cycle.

on Fig. 31, we may likewise extend forward the product X cycle line. To be sure, we must consider the possible reasons why our line may not, this coming year, react just like average business. But having projected forward our X product's cycle index line, we may readily

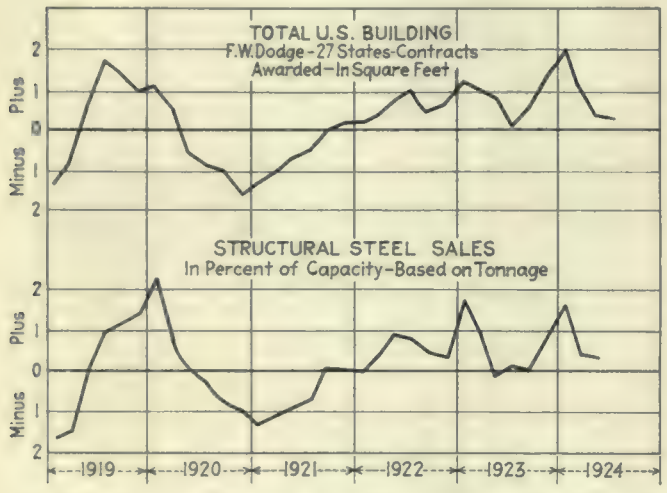


FIG. 32 BUILDING CYCLES AS A FORECASTER OF STRUCTURAL STEEL CYCLES
Bi-monthly averages used in plotting curves.

discover its meaning in terms of X product orders month by month.

It is remembered that the average seasonal variations are eliminated from the actual order line to get the cycle index line. Consequently, to get finally the forecast monthly tonnage amounts signified by the

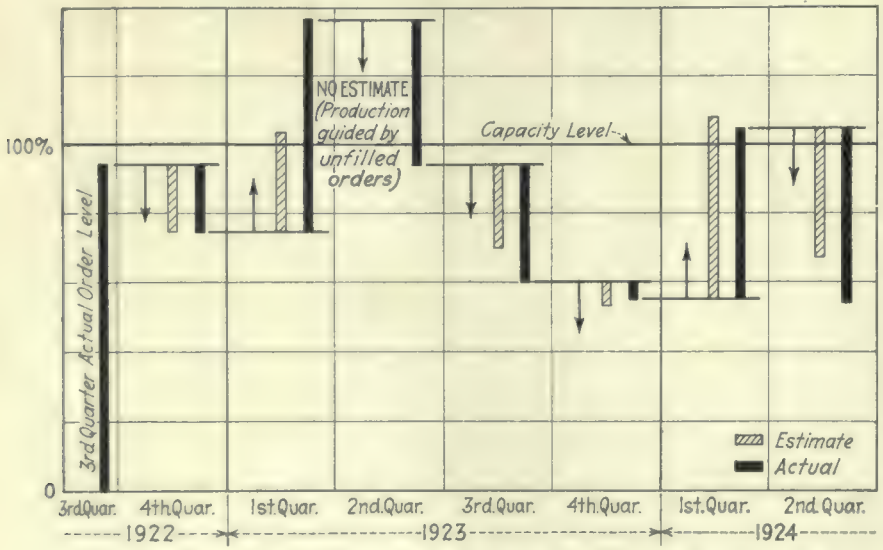


FIG. 33 RUNNING COMPARISON OF ACTUAL VS. ANTICIPATED CHANGES IN ORDER RATE

forecast levels of the cycle line, we must allow, not only for the monthly secular trend growth, if any, but also for each month's seasonal variation.

Is Forecasting of Practical Value?

One cannot help wondering, in the face of so much discussion that sounds like good theory only, whether or not it really helps in practice. How do the performances check up against estimate?

The procedure that has been described in this article is the result of our method's development up to date. The illustration selected has shown the application of these methods in forecasting the cycle of a certain line out of the many lines of our product. But despite earlier and cruder methods, this type of forecasting has demonstrated a very practical value, and it has done so even when utilization of those cruder methods was necessarily limited to forecasting only the movement of the grand total of orders for all products.

The final Fig. 33 shows over a period of several years the actual performance against estimated performance. It checks up the kind of advice forecasting gave us as a basis for planning the quarterly production policies. To catch the significance of the comparison, it will be realized that, in all forecasting, there is always the necessity of determining future probabilities from three viewpoints: First, as to the probable *direction* of the future trend; second, as to the *time* of change in trend; and, third, as to the *extent* of the movement in its general direction.

Valuation Factors

Properly to appreciate their significance, performances need sometimes to be evaluated in the light of the fact that the estimates meant a complete reversal of the trend; that is, an absolute change of "direction". Such comparison supplements the impression gained through comparison currently made of actual volume against estimated volume. Often it is possible to throw into relief the hazard behind the estimate, if we bring out the contemplated extent of change from some previous actual peak level, particularly if this previous actual peak level was the most recent level known at the time the estimate was hazarded.

Even this sort of comparison is often inadequate to tell the whole story. In the appraisal of the effectiveness of "forecasting methods" as against "no forecasting methods," the true comparison should be of the actual results obtained against those that "might have been," had judgment been affected only by "boom" propaganda. Particularly at the very peak point of the business cycle just prior to a decline, there seldom fails to be generated a large store of optimism concerning the future.

The next article of the present series, taking up the practical side of the matter, will discuss the application of these forecasts in budgetary control. In order to be specific, and to illustrate the method of use more clearly, one of the typical problems of administration—production control—will be selected to show how definitely forecasting helps to stabilize production and employment and does this in spite of the erratic nature of our order demand.

The next article, carrying forecasting to its practical application, is the last of the series.

Profit-Making Management in the Factory

Work of the Industrial Executive—V

By B. A. FRANKLIN

Vice-President, Strathmore Paper Company

THE conduct of an industrial unit involves, necessarily, in its broadest relations, the interests of many people—the public, its stockholders, its workers of all classes.[1] These interests lie in the hands of the industrial executive, and he must be essentially, whether in the chief or a subordinate position, a manager if he is to handle these interests with the success rightly expected of him. It seems, therefore, not merely logical but necessary that he should have a clear understanding of the principles underlying management and the methods of operation based upon them, and that any variations from a standard practice of fair management ought to be made for the sake of better results and as a matter of ability and not because of a lack of knowledge. For, of course, in the practice of any art or science, results always vary with skill and ability, no matter what the knowledge possessed.

This is, of course, all sufficiently plain and unnecessary to call to attention, were it not a fact that so many managers, even among those who are successful, have a very hazy idea of the definite principles which underlie management, or are unfamiliar with the developed and developing methods in the application of them. For the average manager rises to that position either through the fortune of possession or through a background of experience and a development of ability and common sense—splendid possessions which, with shrewdness, not only make for success, but indeed also for the development of many practical methods of management. The average manager does not, however, as in most other professions, usually operate with an educational training as a basis.

Management, in theory, is developing as a science, with certain agreed-upon principles, necessarily broad. Out of these principles there have been developed and are being developed, often unconsciously as to those principles, certain methods of application which bring improving results. Yet when it is considered that management has to operate through and with human nature, varying in individuals, in groups, in localities, in periods, in circumstances, and with varying skill and experience, it may be said that management in its practice is still an art. For, as in painting, the colors mixed in a definite way and proportion will necessarily produce the same result, yet in the hands of different artists, even in depicting the same scene, the results will differ materially, as not knowledge alone, but skill is a deciding factor.

Industrial management may therefore still be defined at its best as the art of operating with a group of human natures through the knowledge and use of scientific principles, and the best developed methods of practice, based on them, to produce, in a given field, the best results for the public, the stockholders, and the co-operators. With the proper, yet practical, idealistic viewpoint, there rests in management then the amplest opportunity for both the best ability and the highest ambition. And it ought not to be forgotten or misconstrued in any consideration of the science of management, that very often indeed the practice of management is highly successful in the hands of shrewd, forceful, able leaders who, consciously at least, have no knowledge of it as a science, while the knowledge, without these qualities, may result in failure.

As Mr. Franklin understands industrial management, it is a service, and therefore good management is a duty. Product must be of good quality and sold at a reasonable price; stockholders must receive four dividends; employees must be well-paid and contented; and the plant must be properly maintained. The present article explains how largely the methods of modern industrial engineering may be utilized in serving these much-to-be-desired ends.

Industrial management is essentially a matter of engineering. It makes use of all branches of engineering, but what is particularly known, latterly, as industrial engineering. Industrial engineering is that branch of engineering which has to do with the knowledge and practice of those methods which obtain in an industrial unit the most economical results in standardized quality. It follows, of course, that an industrial executive ought to be, if not an industrial engineer, at least in touch and sympathy with its developed and developing methods, for they unquestionably are the basis of the best industrial management. Where this knowledge does not exist in any industrial unit it is almost invariably a requirement of future success to engage the services of an experienced and practical member of the industrial engineering profession to install its methods.

The methods of industrial engineering fall into a few main groups, back of which are certain fundamental common-sense reasons so sound and essential as presumably to force them into practical operation and use in any industrial unit, once they are comprehended.

[1] For preceding articles see MANAGEMENT AND ADMINISTRATION for September 1924, p. 249; October 1924, p. 391; November 1924, p. 513; December 1924, p. 611.

The first of these groups which ought to be of prime interest and importance to the industrial executive has to do with costs and statistics. It would seem almost ridiculous at this late date in the development of industrial engineering to spend any time in the discussion of this group, were it not for the fact that so many industrial units are operated without its complete assistance. The fundamental difficulty is that the industrial executive considers himself generally a practical man backed by the possession of experience and common sense and a knowledge of his business, with which he feels himself able to decide on the best method by a sort of prescience—an instinct which enables him to give the proper directions and to have them executed implicitly.

The facts of the matter are, however, indisputably clear, for the daily progress of any industrial unit, even where its processes are simple, involves vastly more operations than any one executive can oversee, more decisions than he can make, more orders than he can give, more opportunities for loss than he can control, more occasions for improvement than he can take advantage of, and even if he could, there are other matters which ought to take up his time so much more valuably that he must trust some of his functions at least to a line of subordinates. The working of almost any industrial unit is a continuous and complex set of operations, and the outcome is the composite result of varying energies, intentions, abilities, failures and successes, both of direction and performance.

Out of all this comes a finished product which, in theory, is to be of standard high quality, and standard low cost, and the responsibility of this attainment rests upon the industrial executive. What he needs, if he is best to fulfill that responsibility, is knowledge—detailed knowledge of men and operations of the past as a forecaster of the future, of results in relation to standards, of costs in relation to prices. Then his experience and common sense, his executive ability and control, with this fundamental basis of fact, have the greatest opportunity for profitable expression. It is only an indication of the operation of a business common sense, and not a negation of its use, when the industrial executive sees this value and insists upon it until he obtains it, which may be done through the operation of a proper cost system.

The Cost System

Of course, in almost all industrial units there is some species of cost knowledge, but in too many cases it is very incomplete and superficial, and presents to the executive no true running picture of the situation—one that will give him a basis for fair judgment and action. This is due not a little to a fear of clerical expense, but it is probably more frequently due to the inability of untrained or uninspired clerical effort to cast up and present the figures of operation, and inability of the industrial executive to show how it should be done. The result is that the costs and statistics presented offer nothing of that significant value which makes a cost system important and profitable.

A proper cost system is always capable of operation at a clerical expense of from ½ to 1½ per cent of the total income, according to the size of the business, and much of the work involved in it, like pay-rolls, etc., must necessarily be carried on in any case. A proper cost system always makes promptly clear cost relations to selling prices, variations of operation costs from standards, the economical effect of changes in methods or men, waste losses, the relations of materials, labor, and expense by departments, and their variations from standards. If in addition to these results there is found in the cost system that simplicity of detail and elasticity of operation which will permit the executive to ask for and obtain immediately an accurate standard estimate of the cost of the whole or any part of a producible article by operations, and if the costs are so proved by the books as to be indisputable, then the executive has all the cost knowledge he needs—but no more. No modern unit is best managed without these complete and proved facts.

If, however, the cost system is to be made effective to the greatest degree, it must first operate in relation to set-up standards of cost. This is, of course, in any case merely a matter of common-sense practice, for most articles are sold at a predetermined price and produced by operations already worked out. It is merely the part of good management to build up the standard as well for cost as for equipment and operation. This precludes guesswork or departure from the standard without warning, and offers surety of management instead of mere hope and trust. It is a simple fact of human nature that it operates closer to standard when it knows it is leaving behind it a watched record.

The Operation of the Cost System

The industrial executive, starting with a definite plan, and being informed by a right cost system of the accuracy or discrepancy of the operation to the plan, has the great fundamental of successful production. With it he is driving; without it he is drifting. Successful management is a driving process.

Since, of course, time and the pressure of important considerations do not permit the industrial executive to be constantly considering cost details, it is the essential part of a right cost system that the cost executive and his subordinates shall be of such caliber as to be able, and to be depended upon, to report discrepancies, and to present in report form, for the running attention of the executive, those figures which are most significant of current operation.

The chart method of showing conditions of progress has for some industrial executives, especially if the standard is likewise shown on the chart, a great advantage, because a glance will show the comparisons and fluctuations over a considerable period. One company has developed a chart book which shows the progress of all departments in their critical phases continuously, offering thus not merely a sure and quick basis of criticism and consultation, but a starting point for definite consideration of change and improvement.

Then too, it is the part of wisdom to make a part of the cost system a set of records of production comparisons, of wastes, of sales, and of the various details thereof, together with, from time to time, the addition of such reports as will tell clearly the story of experiments and matters needing control, all of which should make a complete running comment on progress. That these shall not overlive their usefulness, the whole system may be gone over periodically to test the practicability, usefulness, completeness and efficiency of every part of it.

The accounting system will, of course, be arranged to prove and utilize the cost facts and to show the progress as a whole as well as to show clearly the financial situation.

This group of methods of industrial engineering then gives the first essential of management—knowledge. No industrial executive can afford to be deprived of these methods. Innumerable cases may be quoted of large improvement based on them, and if perchance there may also be quoted cases of ineffectiveness, cases of systems too complicated, cases of good existing cost systems and failure, the facts would probably also indicate either an inability to utilize them properly, or inevitable failure because of other causes.

Cost systems and their operation have now been so well studied and such standard mathematical practice has been developed for them, that to attempt to operate them with less than standard detail and proof is as dangerous as to attempt to do a complex problem in the head. For the wise industrial executive, a cost system properly enlightened by statistical records is a fundamental requirement.

The Budget System

A method belonging to the industrial engineering group having very distinct merit, and still somewhat in the course of development, is the budget system. This, in brief, is merely the standardization in advance detail, of certain expenditures or attainments. In some branches this method has long been in practice. It is, for example, quite customary to budget advertising expense because this is an arbitrary expense, changeable at will, and which necessarily, if intelligently and constructively handled, must be planned well in advance and in definite figures.

One company, however, budgets, in detail of material and labor, its repair and improvement account. Another company budgets its expense in detail, department by department. One very large company has been budgeting for several years its whole business, prognosticating its sales, building up its cost of production thereon and laying down in definite figures its anticipated progress and results. Such complete use of the budget system demands, of course, a considerable use of costs, of statistical knowledge of the past, of prognostication of the business future, and of good judgment. It is of course also subject to correction at regular periods.

This complete budgeting will probably make slow headway, because it involves a combination of knowledge of detail and of judgment which most industrial executives are either unable, unwilling, or unprepared to exercise. It involves some period of experiment and experience to bring it to regular and confident operation. Yet it has very many attractive features. It reduces management to a more scientific basis. It substitutes a thought-out and calculated plan for opportunism. It offers an opportunity to attain success badly needed by many units. It concentrates the attention of the executive organization members on a definite minimum result. Even if not completely utilized, the budget system can be, with definite profit, much more largely used in industry.

Incentives to Production

Probably the next most important group of methods has to do with incentives to production, or, to put it in another quite logical way, reward in relation to effective effort.

Despite the fact that less than 50 per cent of all workers in the United States are rewarded for their labor on any other than the straight day-work plan, it seems entirely logical from all points of view, if the philosophy of reward by skill is to prevail, that for practically every task in an industrial unit there ought to be an incentive plan or proportional result reward. Of course the day-work plan itself is, in a general way, an attempt, at least between grades of work, to accomplish this, but it does not usually, especially under labor union rules, distinguish between individuals in the same grade. The executive desires the most economical result within standard quality. The worker desires the maximum reward. The necessities of competition demand reasonable labor cost. The good of the public demands lowest cost. The exigency of profit needs not so much the lowest labor cost as it does highest production per hour, bringing thus, through reduction of expense per unit cost, the lowest total cost. Nothing else will satisfy all of these desires and demands except a method which will bring about the greatest production per man-hour, at the same time reasonably and automatically allotting to each its intended portion. This can only be accomplished by an incentive plan.

The worker by nature and union education is inclined to fix a minimum production as a fair return for a fixed reward. Many cases illustrating this fact might be cited, but a widely spread and injurious one is that of bricklaying, where, as in England for example, 200 per day is the fixed amount, with something more in the United States, as against a possible accomplishment of 5 to 10 times that amount. In industry generally few such restrictions exist, but there does often occur what is termed "a fair day's work for a fair day's pay".

Industry in the long run must proceed along the line of the laws of economics of maximum value to all. It is really the disregard of these laws which causes a good many of our industrial difficulties. Our fluctuating business cycles occur, or at least are accentuated, either because we have no one who can gage in time the composite tendency of all the various movements, and interpret for us the result and operation or economic effect; or because the various inde-

pendent minds controlling industrial units, in the effort toward profit, cannot themselves be controlled. There are certain conceptions of what might be done, eventuating here and there into efforts and often results, which are based rightly on the law of economics, that greater volume brings lower cost, and greater production means more for everyone or less hours to work. Thus in America the industrial executive struggles for volume production, the worker for shorter hours, the public for smaller prices. These could unquestionably in a greater measure all be obtained and, within reason, would be advantageous to all if there were more complete and thorough cooperation to secure them. Certainly that view of industry as primarily a public service and a service center, if more closely operated as a practical idea, would bring them about more nearly. Under all the circumstances of human nature, however, this effort can best be made effective by incentive plans, which make the accomplishment of maximum production desirable to all.

Payment Based on Results

There are a considerable number of incentive plans, each one more effective than day work, having for their aim greater production per hour, lower unit costs and increased worker's hour reward. Each of them has its advantages under certain conditions, and in their installation the conditions should be carefully considered, as it is often advantageous to apply several different plans in one industrial unit.

One of the failures in the use of incentive methods is due to the fact that many of those who use them do so incidentally instead of as a complete policy, utilizing them in a few places and elsewhere operating the day-work plan. This does not do complete justice to either plan or the workers, and does not popularize such plans, since workers in one unit desire to be treated alike. As a matter of fact there is practically no work of any kind which may not be operated on some incentive plan. It is merely a question of finding a unit of result for either the individual or the group. One successful company has practically every one of its workers, direct and indirect, including shippers and material handlers, on some incentive plan, which has brought about a general desire to put production forward.

It is not generally understood that the incentive plan may be very successfully utilized for the improving of results other than the hour production volume. One company utilizes it for the reduction of waste per cents on various operations, and also for the effective operation of machines in actual production for the maximum per cent of its possibilities in point of time. Also, instead of paying for production, the reward may be given for machine speed. It may indeed be said of the industrial unit, that if its operation be divided into units of desired results in any and all directions, an incentive plan can be applied with success to the attainment or improvement of each one of them. The uncontrolled worker, with a fixed pay, gladly takes hold of these methods as a fair means of increasing his income, and the result is an economy for the industrial unit.

Operation and Results of Incentive Methods

There is a feeling among some industrial executives that the incentive method is derogatory to quality, but this is purely a matter of education, insistence, and inspection. There is one company making the highest class product of its kind, which, for a great many years, has operated on no other plan.

The wise industrial executive, desiring to create that confidence among his workers which will bring forth their best efforts, makes it a point to reduce no incentive once fixed without a change in method originated executively and warranting a change. It is also advisable to make sure that in no pay period shall the worker make less than his regular rate, and that worker who cannot or will not keep up the average effort necessary to success, should be placed elsewhere.

It ought to be a matter of clear understanding on the part of the industrial executive in dealing with the incentive method, that he has two elements to deal with in the matter of reduction, labor and expense cost, and that it is easily possible for him to put up with the same labor cost per unit or even a greater unit cost than the day-rate unit cost and still produce at a lower total unit cost by the reduction of expense unit cost. He can therefore readily deal as liberally as necessary in fixing his incentives, although he will almost invariably gain on both scores if the worker gains, and will lose if the worker loses.

Incentive Methods and Standardization

Of course the whole group of incentive plans necessarily involves investigation, research, job analyses, the proper study of operations and possibilities through time and motion studies, and a careful study of speeds and machine possibilities, and careful and continuous preparation. It is hardly necessary to say that such a study and analysis in itself, in the hands of the intelligent executive, must be productive of results, even should it not lead to an incentive plan, but it will also be clear that the establishment of the incentive plan after such a study is almost the only way to assure the continuous execution of the established standard.

Practically, also, in this second group would fall standardization, for to make time and motion studies, even to consider the incentive method is to fix, through study, the best method and the fairly expected result in all operations. As a matter of fact, however, standardization is a natural operation of the industrial executive mind since he must and does constantly consider ways, means, and periods of operations. The difficulty, however, usually is that he does this by judgment, common sense or experience-intuition, whereas to do it by study, experiment, and consultation, to set down in writing the arrived-at method, and to concrete the expected results by incentive is to plan the whole operation better, and to

perpetuate the operation of this plan successfully.

This second group of methods of industrial engineering, then, involves the whole consideration of equipment and machinery method, time and fair labor cost of all operations in the industrial unit, and the introduction of plans to bring the conclusions into practical effect and under continuous control. It is needless to say that nothing could be of more definite importance and interest to the industrial executive.

Planning and Producing Methods

A third group of industrial engineering methods has to do with planning and producing—the starting and carrying through of the work. This, of course, is an essential feature of production but it is such a routine matter that it often seems too trivial for discussion. And yet the manner of it may often make the difference between profit and loss in the unit. The usual method, even today, of handling production is to make out an order, either for stock or shipment, pass it to the superintendent's files, and leave it to his judgment and knowledge of the running situation to get results. This is on the presumably logical basis that he and his force of clerks and foreman are in constant touch with the equipment and its ability and the workers and their progress, and that since some human decision must operate and keep up operation, this method gets the most practical results. The modern study and thought of scientific management have, however, taken quite a different view of the situation, resulting in the elimination rather largely of individual judgment, and involving the consideration of all the facts required to bring about a plan of maximum economic production.

In this question of production there are many problems involved beyond the mere putting through of an order. There is the question of the investment in plant and equipment and how to make the most of it; of the utilization of workers' ability and the arrangement of their co-operation to utilize the special abilities of each to the greatest advantage; of the investment of capital in materials, raw, semi-finished, and finished, and the minimum practical use of it; of the arrangement of production so as to supply the desires and needs of customers to their satisfaction; of the steady flow of work and close sequence of operations and an anticipation of any necessity for change therefrom; of the maintenance of tool and equipment supplies and the care of machinery; of maximum hour production and minimum labor and expense cost. It will be seen that there are large matters which ought not to be dependent on any mere judgment unsupported by the facts for continuously profitable and definitely effective solution.

Planning and Production Policies

Very evidently the first step towards the solution of this general problem is the policy to be adopted as to the carrying of stocks, of storerooms of raw, semi-finished, and finished supplies, of tool and repair stores, and of amount and time rate of the stocks to be carried, and of their care and issue. This involves considerable study and calculation, but the proper solution, while it demands constant watchfulness and change, will save large investment and interest charges.

With these matters arranged, the stage is set for planning the work. This may best be done by a special department with usually no other duty except planning and following through the plan, thus leaving the more technical and experienced ability of superintendent and foreman free to train, to advise, to work for quality, to inspect and to facilitate. The order department may be combined with the planning department. The planning should always cover all the orders on hand completely to the supply date as fast as received, and the equipment time should be covered by the plan as far ahead as possible. One company makes a point daily on receipt of orders, not merely to plan their production and shipment, but to notify their customers, when acknowledging their orders, of the date on which these orders will be filled.

There follows then naturally the scheduling and routing of work, the preparation for it, the dispatching, the inspecting, the assembling and shipping.

The old idea of production, in which the matter was left in the hands of the superintendent and foreman, under which the question very often put was "What shall I do next?" is called a routine method, whereas it is quite the contrary. It is a constant hesitating and starting, a speeding and stopping, a result obtained purely by the exercise of unsupported judgment, and it has cost many industrial units thousands of dollars of loss. The modern idea of forecasting, foreplanning, and forestalling makes for an intelligent and active routine, vastly more productive and economical.

Methods of Dealing With the Men

A fourth group of methods of industrial engineering has to do with personnel. Possibly no element in industry is of greater interest, and has less developed and practiced methods applied to its operation and control. This, in view of the fact that it is the only element possessing human nature and an independent ability to act apart from executive design, and presumably acting on a reasonable initiative, is not strange. Human nature is involved, and it must be subject to discipline and control for the obtaining of the best results. While this is true, under the service center idea, the personnel is an integral matter for consideration in the final results with the public and the stockholders and therefore all methods put into action must be just to the men and designed to obtain their harmonious co-operation.

Possibly another reason why in industry so little attention has been paid to industrial engineering and its methods in the matter of personnel by so many industrial units, is because, of all the elements which must be dealt with, human nature is the most varying and least understood. The executive buys a machine on a guaranteed and understood performance. He buys material on a guaranteed formula if he de-

sires. He engages a worker with hope and expectation only, and always with doubt, and usually with no preliminary method of judging the ability and integrity of his performance except by his experience and promise. The group of industrial engineering methods having to do with personnel is designed to enlighten, assist, co-ordinate, and systematize, to elevate, to loyalize, to educate, to satisfy, and to bring to cheerful co-operation this human element.

These methods, from the point of view of system, keep the historical records and statistics of each employee—his entry, service, and departure, and the conditions thereof, and the records of turnover. Most importantly they deal with the question of selection and proper utilization of the ability offered. Here, of course, is a large and important activity which a growing industrial psychology is undertaking to analyze and formulate. Industrial engineering methods undertake the solution of the questions of education and training, of safety and insurance, of thrift and living conditions, of working conditions and bases of co-operation. They are aimed to create a mutual confidence and understanding, and a basis of mental agreement which will, under good management, bring about maximum productive results with the greatest satisfaction to all involved.

These four groups of methods cover the field of internal operation of an industrial unit—of knowledge of reward, of planning and execution, of co-operation. When grouped, then, they appear simple, and every industrial executive will recognize that his methods, as of course they must, fall into these groups, and therein has lain the very difficulty and delay in the progress of scientific management and industrial engineering methods. For management is general, as indeed it must be, and is human, as indeed it must be again. Performance is its gage, but what industrial executive is capable of properly gaging his own performance except by his own knowledge of the methods of management, through study, technical assistance, and experiment.

Industry is essentially, in the production of a single article by a known and standard process, a simple thing, but in the mass production of many articles in price competition, with groups of human natures, a complex problem. The industrial executive, with his responsibility, with finite vision and limited time, must, for effective work, have methods of automatic operation and control. These industrial engineering furnishes, and the forward-looking industrial executive acquaints himself with them. Without them he makes some progress; he does this, however, by the very momentum of established industrial methods and the natural initiative of human nature. If he adds to these the methods of modern industrial engineering, he may achieve a larger success, and the more certain establishment of both the value and the permanence of his unit.

Avoiding Trade Disputes

THERE are over one and one-half million patents registered every year in the United States. But while the United States leads the world in invention, the National Industrial Conference Board finds that very frequently many patents are kept from use by conflict which is avoidable.

One of the most striking features of the work now being done by trade associations, says the National Industrial Conference Board in a report which it has prepared on this subject, is the elimination of trade friction from conflicting patents. The establishment of numerous distinct legal monopolies over various devices and articles in an industry is frequently a serious obstacle to the improvement of processes and products, the board finds.

One concern's patent may be "blocked" by another's and neither may be able to develop its full competitive strength. Or each competitor may have some special advantage in one stage of production, but be compelled to forego the best practice in other stages. It frequently happens that while each concern benefits a little by its own exclusive rights, every concern loses more than it gains in this way by the exclusive rights represented by the numerous patents of its competitors.

Trade associations have worked out systems for interchanging patents within an industry which tend to remove these incidental handicaps which patent privileges place upon industrial progress. The most noteworthy of these plans, according to the board, is that of the National Automobile Chamber of Commerce, which has been in effect for some ten years and embraces over a thousand distinct patents. This arrangement has never been attacked in the court, and the Conference Board in its report expresses the opinion that it is in thorough accord not only with legal rules, but with sound principles of public policy.

Another of the constructive activities of trade associations described and analyzed in this comprehensive report is the sponsorship of commercial arbitration. The board points out that lasting benefits flow from educational methods which impress upon business men active in the trade a vivid realization of the costs and futility of much litigation, and of the simplicity and general advantage of arbitration in settling commercial disputes. But more significantly, trade associations afford a ready means for the establishment of the necessary instrumentalities of arbitration procedure; and it is stated that many associations, notably the Silk Association of America, have a long and excellent record of work in this field.

While the activities of trade associations have not always been uniformly constructive, and have oftentimes provoked the attention of the Department of Justice and the Federal Trade Commission, this report, which includes a review of this side of association experience also, concludes that on the whole the trade association movement gives promise of reinvigorating the competitive industrial system. The wholesome possibilities of properly directed and properly safeguarded business co-operation are emphasized.

Steel Sash—More Light

By R. S. BISHOP

Industrial Sales Department, Detroit Steel Products Company

IN the attempt to make lighting conditions inside factory buildings as nearly as possible equivalent to outside lighting, great improvements in artificial illumination have been made. In spite of this it is still true that the best artificial illumination does not fully replace daylight in factory operations. For this reason, much attention has been given to the design of windows and sky-lights.

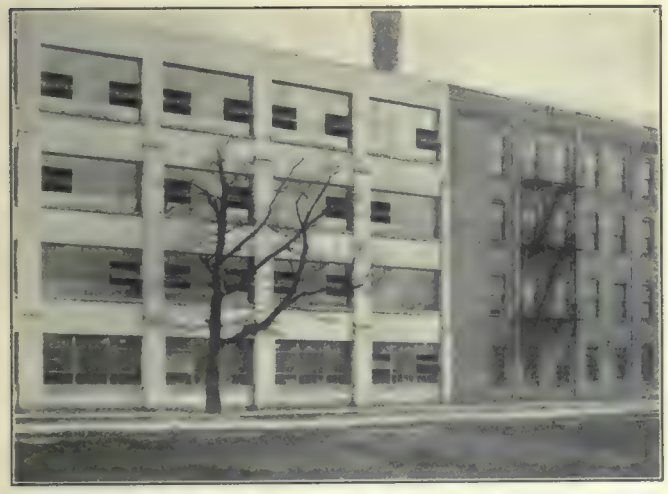


FIG. 1 NEW AND OLD TYPES OF FACTORY BUILDINGS

At the present time the latest development along this line is the steel window. Although this type of window has been available in some form for more than a decade, only within recent years, particularly since the war, have its advantages been fully appreciated by factory owners and managers. Today it is almost universally accepted by industrial architects, contractors, and factory executives as an important and necessary part of the equipment of factory buildings. Not only are steel windows being used in new buildings, but old buildings are being altered so that the usefulness of their remaining years will be increased by improved interior lighting made possible with steel windows.

The greatest advantage of steel windows is the improvement in working conditions. Except for the columns necessary to satisfy the structural demands, the entire side of the building, from a few inches above the floor to the ceiling, is a solid expanse of glass. The great difference between this type of construction and former methods is well illustrated in Fig. 1, which shows the old and the new, side by side.

With little obstruction to the entrance of light, the factory interior becomes a pleasant place to work. There is less eye-strain, fewer mistakes are made, spoiled material decreases in quantity, and production increases. These are direct results of better lighting. There are other indirect results, which, though important, are not often so closely connected with the lighting conditions as they should be.

These include accidents, lost time, labor turnover and similar items relative to personnel. They depend to a large extent upon the attitude the employee takes toward his job and anything that adds to his comfort and convenience is sure to have a favorable effect upon his deportment. It is easy to believe that working under conditions such as are illustrated in Fig. 2 is, as far as lighting goes, pleasant. This is a mill interior of the Black Cat Textiles Company and is a fine example of the possibilities of natural interior lighting when steel windows are used.

Positive and efficient ventilation is made possible with steel windows. Ventilators along the top and bottom of windows and also in roof monitors can all be connected to a single control. By this means the foreman or some other responsible person can control the ventilation for each room. This is a decided improvement over the old-fashioned method by which the shop ventilation was the composite result of each workman's preference. With steel windows their control is positive and instantaneous. In case of sudden rain, high winds, or quick change of temperature, all windows can be instantly regulated to meet the needs of the occasion without taking workmen from their tasks or interrupting their work in any way.

Steel windows are fire-resisting. In fact, a properly installed steel window, glazed with wire glass, is considered 100 per cent protection unless it is broken by falling timbers, masonry, etc. An example of this occurred in the disastrous fire of 1913 in Dayton, Ohio.

FIG. 2 INTERIOR OF MILL OF THE BLACK CAT TEXTILES COMPANY, SHOWING GENERAL IMPROVEMENT IN LIGHTING AND VENTILATION WHICH STEEL WINDOWS MAKE POSSIBLE

The Beaver Power building of steel and concrete construction and equipped with steel windows served as a retreat for more than 200 refugees. Every other building in the vicinity was destroyed, but the Beaver Power structure came through intact.

Even when damaged during a fire, steel windows can usually be repaired at a fraction of the cost of new

FIG. 3 PLANT OF THE MANUFACTURERS PRODUCTION COMPANY, DAYTON, OHIO, AFTER A DISASTROUS FIRE

equipment. Fig. 3 shows the plant of the Manufacturers Production Company after it had passed through a disastrous fire. Fig. 4 is a picture of the same plant after the steel windows had been straightened and reglazed. Replacement of some of the weathering sections and straightening were the only things necessary to recondition the windows, and this cost about 11 per cent of the price of new windows.

Ordinary maintenance work on steel windows is light. Besides periodical painting and repair of accidental damages, there is practically nothing further necessary in order to make them last as long as the building itself. Obviously, steel windows are much less subject to damage than wood windows, and they neither warp nor decay. Consequently, steel windows last much longer and cost less to keep in repair.

Installation of steel windows is quite simple and may, except on large contracts, be handled satisfactorily by any competent general contractor. The windows are delivered to the job already assembled, with the exception of attaching the locking handles and stay bars. In nearly every case they are installed in openings left in putting up the wall. After inserting the windows they are grouted at head and joints to assure tight waterproof anchorage.

Because there is little assembling to be done on the job and because the work of grouting is simple, considerable speed in erection is possible. An example of this is a record of 328,000 sq. ft. of sash installed recently for a large motor car company in 10 days. About 90 per cent of the sash used was of standard size and design, so that rapid shipments were possible. Starting with 19 erection men, which number was increased 3 days later to 77 men, it was possible to maintain an average of nearly 33,000 sq. ft. of sash installed daily for 10 days.

It would be difficult to make any general comparison of costs between steel and wood windows. In the first place, no fair comparison can be made between two products whose applications and advantages differ so widely. If an up-to-date steel window installation, with its wide expanse of glass, were to be duplicated in wood it would cost considerably more. Any attempt to achieve with wood the lighting and ventilating results possible with steel would be prohibitively expensive.

Although in some cases steel windows cost less than wood, generally the first cost is greater. Owing to their longer life and smaller maintenance cost, steel windows will nearly always prove more economical than wood, regardless of their greater first cost. And, of course, the owner of steel windows enjoys the advantages of better lighting and ventilation, and fire protection.

That steel windows are economically advantageous is evidenced by the increasing number of them being installed. One large contracting firm has used over 600,000 sq. ft. during the last three years, and another firm of engineers and contractors has installed more than 1,500,000 during the same period. Such records as these are convincing evidence that steel windows are recognized as valuable adjuncts to modern factory buildings.

Steel windows are also being used to a considerable

FIG. 4 THE SAME PLANT AFTER THE STEEL WINDOWS HAD BEEN STRAIGHTENED AND REGLAZED AT A COST FAR UNDER THAT OF NEW SASH

extent in office buildings. Usually offices require better illumination than factories, but they also have been given more attention by the designers of artificial lighting units. The result is that although many office buildings have very efficient artificial lighting installations, quite often the advantages of natural lighting have been sacrificed. With the growing realization of the better work possible under natural light, manufacturers are installing steel windows in office buildings as well as factories. These installations are usually of counterbalanced and reversible types.

Export Advertising Practice

By DIRK P. De YOUNG

INTERNATIONAL advertising agencies are relatively new service organizations, that is, publicity concerns who specialize in the foreign field exclusively, and as expertly as similar agencies here at home. For years American advertising agencies have placed copy abroad, but they made no specialty of the work. Now some of the older and larger domestic agencies have men who specialize more or less in international publicity. But in addition to that there has grown up in recent years a group of international advertising agencies, who make the foreign field, and no other, their sole profession.

Ahead of these international agencies, but not quite so far back as the flood, individual American merchants have carried on extensive advertising campaigns abroad, with remarkable success, too. Yet many of those now well established in foreign trade, such as the Quaker Oats Company, the Lydia E. Pinkham Medicine Company, the Standard Oil Company, the National Carbon Company, and the Kolynos Company, to mention only a very few, who formerly did their own advertising work in the foreign field, are now turning the details of such work over to the advertising agency, because it is cheaper in the long run and insures better results.

This may sound like publicity in behalf of international advertising agents but it is the truth. Not from the foreign advertising expert, who makes a business of handling export accounts, but from principals who first tried it alone and later handed all their foreign publicity work over to such experts, I get these facts. Such men, for instance, as W. A. Moran, export manager of the Quaker Oats Company, and E. Velasquez, export manager of Kolynos Company, after years of placing their copy, prepared by themselves, direct or through so-called native advertising agents, now give the American international advertising agents all of their work. It costs less, they say, and the work is done better.

Advertising, as we all know, is applied psychology. Before an advertising campaign is launched, much investigation should precede it. Great mistakes can be made if foreign campaigns are undertaken without a careful survey of the projected field. One of these, in which a technical error was made, costing considerable money, will suffice to illustrate the many pitfalls which await the prospective international advertiser. When the Palmolive people started to sell their product in Australia, they got out full-page advertisements, with a coupon good for a full-sized cake of Palmolive soap. One enterprising newspaper, sensing the probability of a great demand for its pages with that advertisement in it, kept on printing copies so long as the public called for them. The result was several special editions, containing coupons by means of which many of the local dealers supplied themselves with Palmolive soap for the season. After that experience the Palmolive people, in placing similar advertisements, made it clear that only the regular edition would be printed.

Fig. 1 Float Used by the Kolynos Company in a Carnival at Havana, Cuba, from Which Free Samples Were Distributed

The Pepsodent people, going into Australia, also made a mistake which newspaper men of that country tell on them. They, too, undertook to sample the country by means of coupons published in the press, with the provision that such coupons were redeemable at the drug stores and the grocer shops. They went right ahead with the scheme at considerable cost, finding out to their sorrow, after it had been actually launched, that the Retail Grocers' Association positively forbade its members to have anything to do with the handing out of free samples of any kind, on the grounds that it hurt their business. They also intimidated the druggists, who as a result would have nothing to do with it, and the whole publicity campaign, put out at much expense, fell flat.

The Quaker Oats Company wanted to introduce their product into South America, about 12 years ago. The Latin countries have no breakfast, except possibly a cup of coffee and a biscuit when the natives arise in the morning, while Quaker Oats here is used principally as a breakfast food. After much investigation and study, company officials evolved the idea of putting out Quaker Oats as a health food—all their advertising copy and all of their sales effort being directed along that line.

Investigations unearthed the fact that the lack of breakfast, and the heavy meal with many meat courses, cheese, and soups, spiced up with hot peppers and cognac, at midday, caused most people there to be ailing and physically run-down. It was also observed that the drug store was the most popular place in those countries, where every manner of pills for all sorts of stomach ills were concocted.

Thus, instead of appealing to the breakfast table, as they have done with their advertising copy in the United States and England, they concentrated on the health-restoring qualities—all of their Latin-American copy being designed to create the single impression that Quaker Oats increases the health and vigor of those who use it. Instead of introducing it via the morning route, they wormed their product into the menu as a heavy meal dish, to go in soups, or as an afternoon gruel to be sipped at tea-time in the homes of the elite. Physicians were induced to prescribe Quaker Oats, while the apothecary shops, as numerous in South America as Candy Kitchens here, dispensed it as "the apple a day to keep the doctor away." The magazine display advertisements, the broadsides distributed, and all the newspaper copy put out by these people emphasized the health qualities of this food.

Mr. Moran, of the Quaker Oats Company, whom I interviewed recently, says that their foreign outlet has been built up entirely through intelligent advertising. According to him, international advertising, put out with the same skill and knowledge as domestic advertising, will get identically the same results. Mediums abroad, too, he says, will pull the same as American publications, when the copy suits the country.

There are export concerns, however, who find their business too complicated to turn over to the international advertising agency. It therefore depends largely on the nature of one's business as to whether or not he should organize his own foreign advertising staff. The United States Rubber Company, to mention a case in point, did place some of its export advertising in the West Indies and other smaller markets through an American export agency, but most of their foreign advertising is handled direct from their different branch houses in the more important markets. Because of their many different products they could not successfully place their foreign advertising through an export agency here.

Well-organized international advertising agencies, of which there are a number in the United States, gather information from most of the countries of the

FIG. 2 SAMPLE OF ORIENTAL ADVERTISING USED BY QUAKER OATS COMPANY FEATURING THE HEALTH-GIVING PROPERTIES OF THEIR PRODUCT

world. Many of them have experts traveling abroad all the time, studying markets, peoples, and media. One of these located in New York City recently reported that it had four men out then—one in the Far East, another in South America, one in Mexico, and still another in Europe. That particular agency has complete advertising data on 48 of the 90 countries of the earth, the remaining 42 being unimportant ones, such as Congo, Algiers, and like insignificant lands.

For instance, outside of England and a few of the

La mujer refleja su gusto en el peinado
El arreglo del pelo es obra de buen gusto. La forma de la cabeza, las facciones, la estatura y la edad deben considerarse a fin de obtener un peinado artístico y gracioso.
Una cabellera abundante y sana facilita un peinado elegante. Para cultivar el cabello el peine Ace es el apropiado e indispensable.
LUIS de BEDOUT
Apartado 252 Bogota
ACE
Ace para Peinarse

FIG. 3 SOUTH AMERICAN ADVERTISING USED BY AMERICAN HARD RUBBER COMPANY

countries of Europe, trade publications are not common. In the United States, when a national advertising campaign is launched in the daily newspapers or in popular magazines, it is the practice to tie it up with a series of ads in trade journals to reach the dealer element. That being impossible in most foreign countries, other means of appealing to them have to be devised. Thus broadsides are prepared containing on one side the reproduction of a full-page advertisement which is being run in mediums of the country at the time of mailing. On the other side is the appeal to the dealer, which ordinarily here would be printed in trade journals.

These broadsides, as well as the advertisements tied up with them, are generally works of art, in which the international advertising expert, with full knowledge of the foreign market and the psychology of people to be reached, appeals to his audience with remarkable accuracy. Experienced exporters tell me that nowhere outside of the United States is it possible to secure

¿Ve Ud?
Esta es la tapa ideal. ¡Nunca se extravía! ¡Nunca se pierde! ¡Nunca ocasiona la más leve molestia! Tan admirable innovación la ofrece exclusivamente la
CREMA DE AFEITAR
Williams
que es reconocida hoy como la mejor que existe por la rapidez con que ablanda la barba más áspera, por la abundancia, la consistencia y el exquisito perfume de su espuma y por la suavidad y frescura que da a la piel.
Para completar las incomparables ventajas que esta Crema ofrece, a cada tubo acompaña un gancho que sirve para colgarlo en el sitio que se quiera.
Si Ud. prefiere jabón en forma de barra, prueba el de WILLIAMS
Celestino Fernández & Hijos
AGENTES Y EXCLUSIVOS PARA CUBA.
LUZ 83-85 HABANA.
MIRE!
Antes era Ud. un esclavo de la tapa. Ahora la tapa es una esclava suya. Ya no se extravía, ni se cae al suelo, ni le hace perder su tiempo cuando está más de prisa. Este ingenioso mecanismo lo posee únicamente la
CREMA DE AFEITAR
Williams
que es, indiscutiblemente, la mejor que existe hoy por la abundancia y consistencia de su espuma, por la rapidez con que ablanda la barba y por lo fresca y suave que deja la piel.
Para que esta Crema sea perfecta y cómoda hasta en el más mínimo detalle, con cada tubo se suministra un gancho que puede atornillarse en cualquier parte y del cual se cuelga el tubo.
Si Ud. prefiere jabón en forma de barra, prueba el de WILLIAMS
Celestino Fernández & Hijos
AGENTES Y EXCLUSIVOS PARA CUBA.
LUZ 83-85 HABANA.

FIG. 4 TWO SPECIMEN ADVERTISEMENTS USED BY THE J. B. WILLIAMS COMPANY IN CUBA

such art work, from an advertising point of view, or such technical knowledge of handling overseas advertising as these American professionals bring to their work. This does not necessarily mean a boost for the international advertising agency either, for some of the large manufacturers, such as the Wrigley people, and the United States Rubber Company, do this work themselves.

The poor equipment of so many of the publishing enterprises abroad, also, makes it quite essential to have the cuts made here in the United States. Moreover, they should not be mounted, because in South America, for instance, three different depths of type are used by different periodicals. Consequently a mounted cut would have to be raised or cut down, which the native printers do not do well. Sending the plate out unmounted, which they then place on the right type-high block, results in a better impression. It is also worth mentioning in passing that many "free readers" are welcome with paid display advertising in the newspapers of Latin America. These are used as fillers and the public, it is said, places great store in the testimonials of the great and near great in behalf of some advertised product.

International advertising also includes the distribution of samples, which for introductory purposes, in many lines, is the best puller of all. But sampling, too, must be done with discrimination. To best advantage, samples are distributed at Carnivals and Sample Fairs in South America. The motion picture shows, with advertising of the product on the screen at the same time, is a good medium generally. Direct-mail advertising is also helpful. In Latin America motion pictures are very popular, even more so than here, and the "movie star" shown on the silver screen of the Spanish-speaking countries is put upon a pedestal and worshipped. The Quaker Oats Company capitalized that characteristic in their Latin-American copy, too, picturing such actors and actresses as beautiful and successful because they included the popular American breakfast food in their daily diet.

Manufacturers who prepare their own copy and place it themselves in foreign periodicals pay the full advertising rates prevailing there, while agents get all the way from 20 to 40 per cent commissions from the publications when they send it in. Since the international advertising agency, as a rule, is satisfied with a commission of from 15 to 20 per cent, it turns over the excess of commissions received to the advertiser.

The scope of international advertising is so broad that men nationally trained only are less than half-equipped for the profession. It takes years of study and practice in the larger fields to qualify for the work. To illustrate more concretely what a variety of conditions the American advertiser abroad is up against, as well as the notable success which some of our pioneers in the field have achieved, a recent interview with Mr. W. H. Stanley, of the Wm. Wrigley Jr. Company, is worth mentioning. Fifteen years ago, when I was stationed abroad, I had to send to the United States for chewing gum for my wife. She could not buy it in the shops of Amsterdam, and like

all other American girls of that day, and of the present generation also, she had to have gum. Now, not only the Dutch chew gum, but even in faraway Iraq, wherever that may be, a Y. M. C. A. worker recently reported to headquarters in the United States that three things were very much in evidence there—Ford cars, Remington typewriters, and Wrigley's chewing gum.

The Wrigley people established themselves in England in 1911, beginning by advertising in British publications through which they also got orders from the colonies. Following up the publicity work in the press, all kinds of propaganda and advertising schemes were employed, supplemented by personal work. In places like Japan, where the newspapers do not reach such a large proportion of the people, the Wrigley Company appealed to the public by the use of bands decked out in flags and banners, accompanied by "spielers" who mounted a soap-box, extolling the uses of gum. While lecturing thus the speaker would demonstrate it, stretching it out between his fingers and teeth, American-kid fashion. In China, samples were given away in tea-houses, trips were made into the interior, miles up the rivers, where circulars and samples were distributed, supplemented by cinematic advertising.

During the famine recently in the Shantung Province of China large quantities of Wrigley's gum were distributed to the natives from the American relief stations. Chewing gum became such a favorite article with the Chinese that the relief workers were able to force the rural people to take a bath every day before receiving their daily stick of "Perfumed Lily of the Valley," as they called gum. Many of the natives also considered the product as a great relief to their stomachs, took it for stomach troubles, and often walked miles to a relief station for one stick of Wrigley's chewing gum, which they hailed as the "great medicine with the green spear."

The Wrigley company simply adapted their advertising to the conditions of the country to which it exports. It only needed the right kind of propaganda machinery to popularize gum throughout the world. Although, to start with, chewing gum was strictly an American diet, it appeals to all who have teeth in their mouths, and to some who have not. An intelligent international advertising campaign alone was required to create the universal demand. With the Wrigley concern, the same as with the Quaker Oats Company, that was a matter of study of each particular foreign field, capital to back the plan, and men with the skill to execute it.

In every successful foreign advertising campaign it has been necessary to analyze the psychology of the people it is intended to reach, to study local conditions and prepare copy that will be applicable to the proposed field of operations. International advertising agents are often in possession of information concerning the habits and customs of foreign countries, so that they can offer great assistance in the preparation of an advertising campaign. With their assistance the Quaker Oats Company have greatly increased the results of their South American campaign to emphasize the health-giving qualities of their product.

Bull fighters, prominent men and beautiful women of the stage and screen, and influential statesmen have been induced to give testimonials and these, together with photographs, are worked into advertisements. In the Latin countries this style of advertising is particularly efficacious, but it requires deep knowledge of the country to realize it and adopt it in campaigns.

The point which seems to be of most importance in considering foreign advertising is that, although underlying publicity principles are the same regardless of what is being advertised or where, practical applica-

Medias Snugfit
(Pronúnciese esnogfit)
DONDE quiera que haya damas de gusto refinado, allí se encontrarán las Snugfit estas medias son las compañeras inseparables del buen tono. Las graciosas líneas de las piernas femeninas resaltarán sus encantos al cubrirlas con el tejido finísimo de las Medias Snugfit.
Mercerizada, seda vegetal y seda pura
Snugfit
SNUGFIT HOSIERY CO., New York, N. Y., U. S. A.
AGENTES VENDEDORES:
Gonzalez & Llano
Celestino Delesto
"AL COMPRAR: Snugfit sin vacilar"

FIG. 5 EXAMPLE OF ADVERTISEMENTS USED IN CUBA BY SNUGFIT HOSIERY COMPANY

tions of those principles vary widely in different countries. To be successful a foreign campaign must be started only after complete information has been obtained about the country and its inhabitants.

This task is simplified by obtaining assistance from those organizations specializing in such work. These agencies either have translators of their own or hire free-lance writers, generally natives of the country to which the copy goes, to prepare the written part of the layout. Staff artists under the direction of skilled foreign advertising men adapt the whole ad to fit the needs of the case.

In making a decision between native advertising agents located in foreign countries and American agencies, the latter are to be preferred. Native agencies merely place copy and collect commissions, while American agencies do it all, or nearly all, and cheaper, from preparation of the copy and cuts to selection of media.

Measuring Sales Effort Results

The Fallacy of an Average Cost in Advertising and Selling

By W. A. McDERMID

Promotion Sales Manager, Hoover Suction Sweeper Company

A RECENT skit in *Life* portrayed the "average man"—a ludicrous figure, but not more so than some of the "average costs" of selling that are sometimes accepted as an accurate measure of selling results.

To a concern with national distribution, or what passes for it, it is comforting to be able to say of that national volume, "our selling expense, including advertising, is such and such per cent." It is more than probable that at this percentage the margin of profit is fairly satisfactory, and that this average compares favorably with that of other concerns in the same industry.

We are, however, confronted in these parlous days with a persistent demand for a reduction in selling expense, and while in some instances this demand may be unwarranted, it behooves the sales and advertising executive to bestir himself to see if, indeed, his fences need mending. Nothing will be more fatal to the success of his efforts than to deal in averages. He will not only get a false picture of the conditions as they exist; he may be left without the basis for a satisfactory remedy.

The average sales or advertising executive is not normally a "figure hound"—in fact, there are a number of valid reasons why he should not be expected to be. But since there is no logic so remorseless, and no solution so satisfactory, as that of fact rather than opinion, a decent regard for arithmetic often gives the answer to some difficult problems of distribution.

In fact, observation seems to warrant an attempt at an epigram, to the effect that good sales management (taken for the moment to include advertising) is very largely a question of good accounting. Certainly a very large percentage of blunders or failures may be attributed to an attempt to make the multiplication table come out wrong. It is not only because figures frequently conceal facts, but because they do contain them, that a course in elementary analysis may be suggested as a valuable supplement to sales strategy and advertising technic.

The analysis which follows is taken from the experience of one of the most successful concerns in its industry, making a packaged, branded product of truly national distribution. To its very success may be attributed first, the kind of data that was available, and second, the open-minded willingness to go through to find out the truth—a freedom from self-complacency which is perhaps rare.

A conspicuous feature of the analysis is the fact that it is entirely based on facts available within the business. This is not an argument against an external research. In point of fact, the concern has profited by various such researches. The analysis in question was made by outside counsel with practical sales and advertising experience, not an accountant, sufficiently divorced from the business to have not only an impersonal viewpoint, but the leisure to follow the thread of the analytical method and the reasoning from the results.

Perhaps the internal records in question are particularly good, but the average concern can usually get all the information that is really needed—in fact, the common experience is that the facts are compiled in some standard form but they are seldom reclassified and

Analysis of "Assets"

Factors	State A	Rank	State B	Rank	State C	Rank	State D	Rank
Total Population								
Per Cent of pop. to total pop. in U. S. A.								
Per Cent of Units shipped to population								
Per Cent of Units in state to Total U. S. A. Shipments								
Per Cent of Retail outlets to total U. S. A.								
Per Cent of Jobbing outlets to total U. S. A.								
Retail outlets per M population								
Jobber outlets per M population								
No. of retailers per jobber in state								
Per Cent of Urban population								

Find index number for each state (composite of rankings).
Find Per Cent that the index number for each state bears to the whole.
Use Unit Per Cent for measurement of quota, sales result, advertising, etc.

FIG. 1 ANALYSIS OF FACTORS GOVERNING THE MARKET

analyzed to yield the conclusions they conceal. In by far the majority of concerns, the analyst, aided by a calculating machine operator, and armed with the standard reports of the business and the census statistics, can settle some questions that have been long debated, and can point the way to unexpected economies.

There are, without doubt, many concerns in which the spread between the highest territorial cost and the lowest is so small that their "average" can be taken as fairly indicative of the true situation everywhere. For such concerns there is perhaps little benefit in an analysis of this kind, unless it be to guide the territorial distribution of parts of its advertising effort a little more effectively.

The majority of concerns are probably not so situated. They have conspicuously high-cost territories, and some at the other end of the scale, and these variations are sometimes appallingly wide when they are dragged out from the camouflage of "average cost" and made to stand out in all their nakedness. Here is

where the leaks exist, and here is where a simple analysis functions both as a detective and as a physician.

The basic work sheet of the analysis is a sheet of columnar ruled paper, pasted as necessary to provide 30 or 40 headings down one side and columns across for 48 states and the District of Columbia, or 49 columns.

The state is taken as the unit of comparison in spite of the fact that with many concerns these do not coincide with territorial lines. If the territorial divisions are on a county basis, the method still holds sound, but the amount of labor involved is considerably greater. Nearly all the pertinent statistics are available by counties as well as by states—the exception probably being those of distribution of sales and advertising effort.

Such a refinement, however, is generally not warranted. The ready accessibility of all figures by states is a big time-saver, and the conclusions, if sound and true as to states, can be broken down later into county groups by simple rule-of-thumb methods of sufficient accuracy.

There are certain facts that are available within the business, and there are certain familiar statistics that are available from outside sources that serve to measure the size of the market or task.

We begin our work sheet, Fig. 1, with the factors that are "internal" to the business, by states, but since total population is a convenient measurement of some facts, the first item to be entered under each state is population. Population, it may be stated parenthetically, is far more unimportant than is sometimes suspected, in determining the size and kind of a market. It must be checked against many factors before it becomes a sound measurement.

The second factor to be entered is the per cent of unit packages shipped against population. Note that this is not the *number* of packages shipped. As a matter of practice, both for convenience in calculating, and for other comparisons, it will be found desirable to list the total sales by units; but only when the percentage ratio of these sales against the population has been found will there be anything that approximates a measure of the success of the selling effort. Even this alone attaches too much weight to population as a factor, and it is subsequently modified by other considerations.

The next factors to be added are the number of retail outlets and the number of jobbing outlets for the particular line in question, by states, and by per cent of the whole number in the country. These are in turn subdivided to get more accurate valuations as between states, as follows:

Per cent that state population bears to total population
Number of retail outlets per 1000 population
Number of jobber outlets per 1000 population.
Number of retail outlets per jobber

These are all pertinent factors for practically any widely distributed article of universal consumption, but there are others that may have a bearing in individual cases, and this can only be determined by a combination of knowledge of the business, and a brief check-up of the figures.

In the case in question, one important factor was at first omitted from the work sheet—the factor of per cent of urban population. It does not substantially effect the final result, because in every cross-analysis it has been added, and the influence of 1 factor in 9 is obviously restricted. The discovery of its importance, however, is an interesting example both of the method and of the value of the method.

It was sought to ascertain whether racial strains (negro, foreign population, etc.) were a serious factor in this particular business. The states were ranked in their per cent of these populations and then compared with the figures as to sales results and cost of sales. It was not demonstrated that the race factor was important, but in seeking the cause of territorial differences, the factor of per cent of the urban population was added, and it became apparent that here was a factor of far greater importance *for this particular product* than negro population or any other population factor of the kind.

Analysis of "Effort"

Factors	State A	Rank	State B	Rank	State C	Rank	State D	Rank
Per Cent of Total Adv. Expended								
Adv. Total Dollars spent per M population								
Magazine Dollars per M population								
Newspaper Dollars per M population								
Outdoor Dollars per M population								
Store Display Dollars per M population								
Street Car Dollars per M population								
Sampling Dollars per M population								
Per Cent of Total Sales Expenditures								
Dollars of Sales Expense per M population								
Per Cent of Sales Exp. to Sales in Dollars								
Per Cent of Adv. Exp. to Sales in Dollars								
Total Combined Sales and Adv. Expense								

FIG. 2 SALES AND ADVERTISING EXPENSE ANALYSIS

Similarly, the question came up as to whether purchasing power was an important factor in sales results. The census figures of distribution of personal income were applied against the 18 states leading in sales, and it was demonstrated conclusively that there was no apparent relationship between the factors from which any proof could be established as to importance of purchasing power.

Now it is obvious that there are commodities in the sales of which the factor of personal income might be vital. But too often it is only assumed to be (as it was and had been for years in this instance). If it truly is a factor, such a test on a few states will reveal it instantly. If it is not a factor, follow the logic of the figures and time and expense will be saved.

Perhaps some product has for its controlling factor the number of homes wired for electric light, or the number of tractors in service, or the number of acres under cultivation. All right—if these are tangible influences on sales, and if you can check them against

the known sales results and prove that they are, put them in.

When from your sales records and from the market statistics that are so readily accessible, you have completed this section of the work sheet, *rank each state* by its position in respect to each of these factors, giving the highest the first place (1), and marking the ranks by little red ink figures in the proper columns. These rankings will be found to be of the utmost value a little later, when you come to cross-tabulate to find certain answers.

You now have on your work sheet the ranking of

Grouping of States by Per Cent of Selling Cost					
Low Cost		Middle Cost		High Cost	
State	Per Cent	State	Per Cent	State	Per Cent

FIG. 3 METHOD OF GROUPING STATES BY PER CENT OF SELLING COST

49 states by some 7 or 8 factors, and these are designated as "assets" (Fig. 1). This term is applied, perhaps not very happily, as a convenient designation for the size or kind of the market represented by each state. To make the results usable, however, it is necessary to reduce them to some form of common denominator, or index number, so all the various ranks under a given state are added up to give a total figure.

If we have 8 factors listed among the assets, and

Comparison of States by Groups on Basis of Per Cent of Total Selling Cost (States Grouped "Low Cost", "Middle Cost", "High Cost")											
State	Per Cent Cost	Rank	Unit Sales per M. of Pop.	Rank	Adv. Expense	Rank	Sales Expense	Rank	Total Expense	Rank	Appropriation for Adv. in Dollars
A											
B											
Averages	%		%		%		%		%		

FIG. 4 SELLING COST COMPARISON BY STATES

some state is the best in each of the 8 (which of course none will be), its index number would be the sum of 8 first rankings, or 8, so that 8 stands for "perfection" among assets, and a notation to this effect is made for convenience somewhere on the sheet, i. e., "Ideal is 8." These total sums, or index numbers, are now ranked as between states, so that we find each state, with its composite figure, assuming a rank with respect to all other states. For example, Massachusetts and New York tie for first place, California is 9th, and so on. This measurement of the ranking of the states by assets is a most useful figure.

We next come to the second part of the work sheet, and since we have used "assets" to designate the factors of the market, we now use "effort" to cover what has been done to exploit that market (Fig. 2).

At this point much depends on the character of records available from the sales and advertising departments. For the analysis in question, the sales department readily produced the sales dollars spent per state, and the dollars of advertising cost by state, but the appropriations were similarly broken up into dollars expended for different mediums, and for overhead charges, by states, from which it was a simple calculation to determine percentages by mediums.

To the concern that has not a logical and practical subdivision of this kind, it may be stated that such a distribution of expense, if properly analyzed, will many times repay its cost, and amply confirm the statement previously made about the merit of good accounting in the selling end of the business.

Under the group of "effort," then, the following factors were listed, and the ranking of the states worked out and shown:

Advertising dollars spent per 1000 population.
Per cent of total advertising appropriation expended by states.
Expenditures by mediums in dollars per 1000 population:[1]
- Magazines
- Newspapers
- Outdoor
- Store display
- Street cars
- Etc.

Per cent of total sales expense used in each state.
Dollars of sales expense per 1000 population.
Per cent of sales expense to sales volume in dollars.
Per cent of advertising expense to sales volume in dollars.

These comprise all the "effort" factors, but for additional use in making tabulations, and *not* for inclusion in measuring effort, there is added the total selling expense (combined sales and advertising) by states.

At this point you have your work sheet complete, and in the telling, it sounds like a task of formidable proportions. Actually, it is little more than a routine operation, involving a good deal of straight copying and not a very great deal of calculation of percentages. Two people, to read figures and check them back, with a calculating machine, a slide-rule, or even a pencil and paper, can make such a work sheet in the course of a very few days, or even hours.

Now, however, the fun begins, and there are several ways and places to start. You may find that as you have gone along, questions have been raised as to the value of some factors that have been omitted—such as per cent of illiteracy, or, as has been cited, purchasing power, or negro population. Here is a good time to settle those arguments.

Take your 10 or 15 states leading in per cent of unit sales to population, and compare them against the states in which the suspected conditions are the strongest, ranked in their order. If you get a marked coincidence between these parallel lists, you have tentatively established something for further investigation and proof. If there is no noticeable coincidence, you may well assume that for the present, at least, this is not one of your worries.

[1] These factors are each treated separately because they differ by states, not all states being covered by the same mediums.

The thing we are vitally interested in is the per cent of cost of sales, which is a composite figure covering both sales and advertising. We first arrange the states in order of their per cent of selling expense, beginning with the lowest. We know what our "average" per cent has been for the year in question.

We find (in this instance) that 24 states fall into a group within a reasonable range up and down from that average, but that there is a "lunatic fringe" of states, in one group below the limit, and in another group above the limit (Fig. 3). We now have three groups of states—low cost, middle cost and high cost—and we begin to make up comparative tables.

Our first table, then, Fig. 4, is the low cost group. In column one we have the states; in column two, the per cent of selling expense and the ranking of each state with respect to the *other states in the group.* The next column is per cent of box sales to population, and the state ranking; the next is dollars of advertising expense, and rank; the next is dollars of sales expense, and rank; and last is the combined total expense, and rank.[2]

By way of totals, an average of selling expense was taken, and also averages of the four other comparative factors, within the group of states under consideration, and these were used in a later table to compare with the totals of other groups of states.

This table began to indicate that there might be deduced certain relationships between effort and result, but what these were was as yet not sufficiently clear.

When the middle cost group was attacked, the first thing that was noted was that the first 6 states had high percentages of units shipped against population, that at this point there was an abrupt drop, and that the remaining 18 states had all relatively low percentages.

This indicated at once the need for separate study of these 6 states, so they were set up in their own group, and to the previous factors were added "Amount of Advertising Appropriation." This revealed that these 6 states, all with selling costs below the general average, had an expenditure for advertising six-sevenths as large as that applied in the remaining 18 states in the middle cost group. Here was a definite and unmistakable indication that there was some relation between effort and result.

When the high cost group was tabulated as in the case of the low cost group, the first part of the picture was complete.

A table, Fig. 5, comparing the averages of selling costs in all groups, and also comparing several exceptionally good individual states, showed conclusively that the group nearest to the states best from the standpoint of sales volume had somewhat less than average selling cost, a very much higher relative volume of sale, and the highest advertising, sales, and total expenditures; but it was also obvious which states were dragging behind, raising the average, and why.

The exception to this combination of low selling cost and large sales volume was furnished by the low cost group. Here the average per cent of cost was away below the general average, and it might appear that this condition was satisfactory. But the relative volume of sales was only a little over half of that of the best group, so that the question arose as to whether there is such a thing as too low a selling cost. This tabulation proved to the satisfaction of all concerned that there is; further, that high expense does not necessarily mean a high sales cost.

At this point in the analysis, some conclusions can be reached, either to be destroyed or confirmed by subsequent checking:

1. That there appears to be a direct relation between expenditures and per cent of sales, and an inverse ratio between expenditures and *cost* of sales.
2. That the figures point to the possibility of selecting some sum of money for each state for sales and advertising that will bring the results materially nearer the average.
3. That if the high cost states can be lowered, the average itself will be lowered.
4. That if the sales and advertising methods are improved, the process will be accelerated.

These conclusions, if demonstrable, open to the sales and advertising executives the means to cut their costs, which no consideration of an "average" cost will ever afford. It is therefore highly important to prove or disprove them.

Having, then, ranked the states by per cent of sales cost, we now rank them by *sales results,* or, to translate, by per cent of units shipped, Fig. 6. For simplicity we take the first 10 states, because the rest are, for this purpose, "also rans," although the process can, of course, be applied to all the states.

Here we have the following headings, with the state rank in each case against *all* other states:

Per cent of unit sales (boxes shipped)
Dollars for advertising
Dollars for sales
Dollars of total sales and advertising
Per cent of total sales cost

Here enter also the two Dromios, "Assets" and "Efforts," that our work sheet was built to supply. The rank of each state was shown by each of these two measuring sticks.

Out of the many interesting pictures that this tabulation presented, one fact stood out as clear as crystal: Whenever a state ranked in results beyond or above the position indicated by its asset ranking, there had been placed in that state an *effort* beyond or above its *asset* ranking.

A state that normally should rank first was fourth in results, but was only twelfth in effort. A state which should normally be ninth, was first, with the second highest effort.

[2] In the case in point, no further refinement of the analysis was made, because of a time element involved, but it was apparent that if all but the first column of rankings were to be based on rank against *all* the states, instead of just those in the group, a more vivid picture of actual conditions would have resulted. The essential accuracy of the results in both cases is the same.

Comparison of Averages by Groups and with Selected States

Groups	Average Per Cent of Total Sales Cost	Average Per Cent of Unit Sales	Dollars of Advertising Expense per M. Pop.	Dollars of Sales Expense per M. Pop.	Dollars of Total Expense per M. Pop.
Low					
Middle					
High					
State A					
State C					

FIG. 5 COMPARISON OF AVERAGES BY GROUPS

In the case of 2 states there was a disparity between effort and asset but a tie in results. Since the importance of urban population to this business had been previously established by a comparison table, this factor was applied, and the answer was instantly indicated. The state with the poorer effort was higher by 11 places in per cent of urban population. In other words, the customer was more accessible to the trade.

Without revealing actual figures, or presenting distorted tables, it is difficult to convey the manifold advantages of an analysis of this kind. But once the method is understood, its flexibility is enormous. It can be expanded or refined far beyond the bounds of this application. Any single form of advertising or special kind of sales effort can be measured with really surprising accuracy against results.

The location of the weak spots in the sales and advertising plans, or the effort that is being applied, is interestingly confirmed as the investigator discusses general conditions or past history by selected states. In fact, were it not for the way in which the figures reflect the history, the analysis would obviously be unsound.

That there are flaws and superficialities in this analysis it would be foolish to deny. Many concerns have tabulations and analyses that go far beyond this in completeness, in range, and in conclusions.

But to many a company such elaborate jobs are out of the question, and perhaps for that reason they are prone to assume that they must be content with their reports as they come from the accounting department, take their averages, and hope that they will improve. For such concerns there may be some unexpected value in a little "figure hound" work on the part of someone who can see through the figures to the flesh-and-blood job of making sales.

Analysis of States Ranked by Per Cent of Unit Sales to Population

Per Cent of Unit Sales	States	Rank	Dollars Adv.	Rank	Dollars Sales Exp.	Rank	Dollars of Total Expense	Rank	Per Cent of Urban Population	Rank	Ranking as to Asset Value	Ranking as to Effort	Per Cent of Total Selling Cost
	A	*1st*											
	B	*2nd*											

FIG. 6 ANALYSIS BY PER CENT OF UNIT SALES TO POPULATION

Novel Source of Raw Materials Cuts Costs

THE gigantic kilns of the new plant of the Pacific Portland Cement Co. Consolidated, located on the shore of San Francisco Bay at Redwood City, recently commenced turning oyster shells into Portland cement. The plant is conceded by visiting cement mill experts to be the last word in cement mill construction. It is built of concrete throughout, and the materials in the process of manufacture are handled in the straight line method, with a minimum of transportation from the time they are received until ready for shipment.

The initial capacity of the plant is 2500 barrels of cement per day. This is turned out by two kilns, each 235 ft. long by 10 ft. in diameter. However, the design of the plant is such that as business conditions warrant with the natural development of the territory served by the company, additional units may be added without interfering with operation.

The raw materials used in the manufacture of cement consist of oyster shells in vast deposits in South San Francisco Bay, together with silt or clay washed down from the surrounding hills. The deposits are unique from a geological standpoint, and also from a cement-making standpoint, in that all of the necessary raw materials are contained in these two sources.

The oyster shells are pure lime and the other necessary elements—silica, alumnia and iron—are contained in the clay in the proper proportions for cement making. These shells and clay beds were acquired by the cement company several years ago. They embrace over 30,000 acres and cover practically the entire bottom of South San Francisco Bay on both sides of the channel from Millbrae to Alviso. The company's engineers estimate that the quantity of raw materials is sufficient to supply the plant for several hundred years.

The shells and clay are elevated from the bottom of the bay by means of a suction dredge through a 16-in.

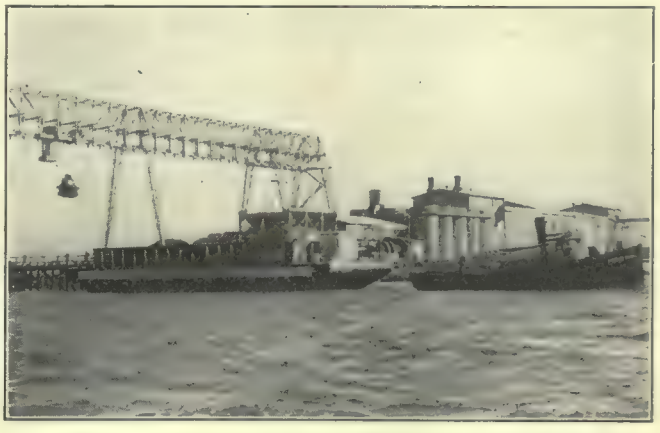


FIG. 1 UNLOADING RAW MATERIALS AT THE DOCK

pipe onto barges alongside the dredge, and are conveyed to the unloading wharf at the plant. This dredge with a force of 6 men replaces the usual 75 to 100 men required for quarrying operations where limestone is used as a raw material, and also does away with the usual incidental heavy quarrying expenses, such as blasting, steam shovels, and heavy crushing machinery.

FIG. 2 GRINDING MILLS FOR MANUFACTURE OF CEMENT

When the barges are towed to the unloading dock, Fig. 1, their contents are unloaded into huge concrete circular storage pits by a giant traveling crane. This same crane then takes the material from the storage pits and places it in bins from which it is conveyed to the grinding mills by means of screw conveyors. One thousand tons of this material are handled per day. These grinding mills, Fig. 2, huge cylinders of steel, are partially filled with steel balls, tons of them, which, tumbling around as the mill revolves, reduce the shells and clay to a fine ground mass.

Conveyors take the material from the mills to large silos, or slurry tanks, as they are called. Here the contents of the tanks are analyzed, the proper amount of water is added, and the material is pumped from one tank to another and into the blending tanks until the exact mixtures desired are obtained. By means of compressed air agitators, the contents are thoroughly mixed and become absolutely uniform.

This soupy mixture, called slurry, is then pumped into the kilns, Fig. 3, mammoth cylinders lined with firebrick, slightly tilted and turning slowly, making one complete turn in 90 seconds. Here the material, rolling slowly down the kiln, is first dried, then heated, and as it approaches the lower end, fused into clinker. The heat is obtained by means of oil, finely atomized, and blown into the kiln under regulated pressure. The heat reaches, in the burning zone, a temperature of from 2300 to 3000 deg. Fahr. Over 300 barrels of oil are consumed in each kiln daily.

The clinker drops from the end of the kiln into steel cylinders, similar but smaller. These cylinders have little racks at right angles to their inner surface, which pick up the clinker and, revolving, drop it back again. This contact with the air cools the clinker. From the coolers, it is taken to the storage pile by another conveyor. Handling is cut to a minimum.

One of the great problems of the cement industry is the elimination of dust. Most of this dust comes from the stacks of the kiln. Aside from public welfare reasons for keeping it down—it is an aggravating nuisance to the surrounding country—there are economical reasons for conserving it. The dust is really a manufactured product and its value in the course of a year runs up to a considerable sum.

The dust chambers at the ends of the kilns were designed especially for this plant by the company's engineers. The gases from the kilns which carry the tiny particles of dust, are passed into these chambers and thrown in and out of baffle plates on which streams of water play. The particles becoming wet, stick together in large masses which are washed into hoppers at the bottom of the chamber and removed. The clean gases go on out through the stacks.

The clinker is taken from the storage pile to another set of grinding mills, similar to those described above. However, the grinding process is carried on in these mills to a much finer degree. To assist in this grinding, air separators are used. The product of these mills

FIG. 3 ROTARY KILNS 10 FT. IN DIAMETER, 235 FT. LONG

is the finished cement. A little gypsum has been added to the clinker, as it has the property of regulating the setting time of the cement, and hence makes it easier to handle on the job. It also strengthens the concrete.

The finished cement is taken from the grinding mill and stored in huge bins. These bins have a capacity of 60,000 barrels. From the bins, it is taken to automatic packing machines where it is sacked in cloth sacks, which are tied first and then filled through a hole in the bottom. The sacks are then dropped on a belt, and conveyed either to the door of the freight car or through a tunnel underneath the plant to the dock and directly into the hold of ocean-going vessels.

The finished product is transported by both land and water routes. The cement company has constructed a dock in Redwood Channel and has dredged the harbor to a depth of 30 ft. In addition to its facilities for barging the finished product to all San Francisco Bay and tributary river points, the plant can load coast and transpacific boats at its docks.

Protecting Foreign Shipments

Insurance Against Credit Risks

By H. L. GIBSON

Secretary, American Manufacturers Foreign Credit Underwriters, Inc.

AMERICAN export trade has not yet fully recovered from the serious set-back resulting from the disastrous experiences immediately following the war. At that time shipments made on credit terms were refused at ports of entry and orders cancelled on such a large scale that nearly every manufacturer engaged in exporting was compelled to suffer heavy losses.

Now that general economic conditions are becoming somewhat stabilized, there is a renewed interest in exporting and many manufacturers are either rehabilitating their lost trade in foreign markets or contemplating such action in the near future. This trend is perhaps augmented by the fact that most manufacturers are finding that the domestic market at present is not sufficient to support their plant capacity and executives are therefore interested in finding a broader field for the use of their product. It is generally conceded to be easier to increase sales in certain foreign fields than to attempt to reach the point of saturation in the home market. It is interesting to note that government reports show some 17,000 American firms now shipping into foreign markets, which is triple the figure of 10 years ago.

The Export Hazards

Every shipment of merchandise abroad involves both a transportation and a credit hazard. The former, resulting from loss due to theft, perils of sea, fire, pilferage, etc., has for many years been covered by fire and marine insurance.

The credit hazard in its broad sense involves both the commercial risk and the insolvency risk. The commercial risk pertains to the moral hazard of rejection of merchandise and repudiation of the contract. The buyer may offer as an explanation of his refusal of the shipment that the merchandise is not as ordered, the quality is inferior, or that some technicality in fulfilling the order has not been carried out, and so many elements may enter into such controversies that the matter of placing the blame on the exporter or the importer becomes a tremendously involved and in many cases an almost impossible task. This particular hazard represents such an intangible proposition that, up to the present time, no means have been devised to offer protection against it although the exporter is anxious to have it covered.

Protecting the Credit Hazard

The need for protection against other people's dishonesty and inability to meet their debts dates back to the beginning of credit transactions. Domestic credit protection has been established for some time but it has only been of recent years that the insuring of foreign credit has developed. There are now only two concerns carrying on this line of business, one in England and the other in the United States.

The insuring of the export shipments of American manufacturers has been made possible by the modern association idea. By means of the pooling of credit information and interchange of ledger experience through one central file, sufficient knowledge of foreign buyers has been built up with which to estimate intelligently the risk and underwrite the consequent credit hazard.

Each individual shipment is handled as a distinct transaction and, if insurable, the company issues a negotiable certificate which covers the full amount of the invoice, that is, the shipper's profit as well as the cost of merchandise and the carrying charges. This certificate carries with it a premium charge predicated on the risk involved and the terms of sale. If the obligation is not met at maturity and there is no indication of uncollectibility, the protection is then automatically renewed for successive periods of one calendar month each at a small additional premium charge. This arrangement is fair, and is mutually satisfactory to underwriters and manufacturers concerned.

The Defensive Function

When a loss is reported immediate steps are taken to verify the claim by investigation in the debtor's community, and if the account is proved uncollectible, the claim is certified for payment. The exporter then transfers title of the goods to the insurance company, which reimburses itself for the loss with whatever salvage can be recovered.

Claims are certified for payment not in cases of bankruptcy alone, but for any cause whatsoever which prevents collection in full, excepting war with an outside country. The broad interpretation of insolvency which comes under the protection involves the following:

Insufficiency of assets to pay debts
Bankruptcy
Assignment for benefit of creditors
Judicial sale of assets
Return unsatisfied of writ of execution or attachment
Internal revolution
Composition

Appointment and confirmation of receiver in bankruptcy
Uncollectibility at law
Sale or transfer in bulk without proper provision for settlement of debts
Absconding
Diversion and resale

In case an account is merely in the past-due stage but where no form of insolvency is apparent, the insurance company takes over the account after a fixed period without further premium charges and proceeds to collect it through its own legal action or else to certify it as a loss. Thus the shipper is assured that every protected shipment will ultimately be collected.

Heretofore the shipper has been practically helpless in the defensive side of exporting. Domestic law firms as a rule are reluctant to handle foreign collection accounts, litigation and the sundry other difficulties connected with exporting which require legal action. The fees of domestic attorneys plus those of their foreign correspondents often absorb the greater portion of the returns from their action and only a small minority have the experience or facilities to give such litigation proper attention. As a result, many shippers have resorted to dealing direct with attorneys in foreign lands, but such resource is frequently disastrous, as the foreign attorney is sometimes as unscrupulous as the buyer himself and works in collusion with him.

Export Sales Promotion

The American insurance company publishes annually a credit guide on the more important market zones, giving the names and addresses of the principal known importers of American merchandise, the class of commodity handled by each and his insurable rating at the time of publication. These guides form a valuable index to the market zones. They can be used extensively in the development of a mailing list by selecting the higher rated buyers in a particular market zone who handle the commodity of the exporter. Even in markets where the exporter is directly represented, the guides give a picture of the market as a whole, and the relative size and importance of his customers can be compared to other firms in a similar line of business. It is also a great satisfaction to have a ready reference when inquiries are received.

By using the credit guide to find the potential buyer and by expanding the export trade through the protection offered by insurance, the actual cost of this insurance can be absorbed by the increase in the volume of business.

The premium rates are remarkably low in comparison with the benefits received. They range in most cases from 1 to 2 per cent of the invoice value and the average might be considered as 1½ per cent.

Advantages to Export Trade

The justification of credit insurance lies in its ability to promote and aid the export trade, through encouraging the granting of reasonable credit terms to worthy importers. Some of the advantages which are already apparent summarize as follows:

Prevention of Loss. As in most types of insurance, the assured is not only reimbursed for actual loss on protected transactions, but the possibility of further losses is minimized. This loss prevention is accomplished, in eliminating the dishonest buyer, by the information compiled through the concentration of the experience of a large number of exporters in a common central file.

Such an organization becomes a powerful influence in foreign fields and dilatory debtors soon find it to their advantage to give insured accounts preference. The debtor will realize that failure to meet these accounts at maturity results in adverse information being automatically placed on record at the insurance company and thus injures his credit standing with a large group of American exporters. Letters of moral suasion emphasizing this point will bring results in a great many instances.

Overbuying is readily detected and the insurance company can prevent loss from this source by closing down on the buyer's insurable line until his outstanding obligations are within the limits of his normal line of credit.

Co-ordination of Effort. To carry on credit insurance successfully it is necessary to have an interchange of credit information and ledger experience. This brings the exporters closer together and encourages co-operation for their mutual benefit. Many ideas for standardization can be more easily promoted.

Duplication of effort can be minimized. The insurance company must know the foreign markets and the status of foreign buyers, and by centralization a large amount of duplication and waste effort is eliminated.

Credit Guide. As previously described, the credit guide on foreign buyers forms a valuable index of the exporter's trade and furnishes a tangible list of potential buyers with which to develop his trade.

Legal Effort. Through the concentration of a number of creditors, litigation can be carried on with greater influence and results will be more satisfactory. A well-organized and powerful legal department connected with such an insurance company has representatives in all the larger market zones. Through such a legal organization the insurance company is able to furnish authentic information and to curtail dishonest practices by taking definite action in each instance.

Facilitating Financing. By protecting accounts through insurance the exporter is able to grant longer terms to the buyer with safety. It is well known that the European competition by years of experience has established a foreign trade on long credit terms. Credit protection affords a means for the American exporter to compete with his European rival on an equal basis. Banks look upon insured paper with greater favor in discounting transactions.

Foreign credit insurance, therefore, offers distinct services to manufacturers of export products. Heretofore co-ordinated effort has been lacking; hence these services were not understood. The results of the war, however, have brought exporters together and made insurance desirable for both old and new shippers.

Standard Costs as an Aid to Profits

Working Plans for Profits—IV

By G. CHARTER HARRISON

Consultant in Management

CONSIDERED from the standpoint of profit making—which is the only proper standpoint from which to consider any business instrument, whether it is a sales policy, a producing machine, or a cost system—standard costs represent a great advance over the old-time retrospective or job-order cost system.[1] A standard cost system should be a great profit maker for a business; if it is not, either it is not properly designed, is not operated correctly, is not properly used, or is subject to a combination of these defects.

It may be stated positively that no retrospective or job-order cost system in a business manufacturing a complex standardized product of great variety can ever produce the profit-making results which could be obtained from a properly designed system of standard cost accounting. A cost system can add to the profits of a business in three ways:

1. In disclosing the existence of preventable inefficiencies, or unnecessary leaks of profits in the factory.
2. In furnishing information as to costs of manufacture which will enable the sales department to obtain that combination of sales volume and sales price which will result in the greatest net profit possible under the general prevailing conditions.
3. In reducing to a minimum the clerical work in connection with cost accounting, whether in the factory or the office.

The retrospective or job-order system regarded from all three of these standpoints has proved an absolute failure in nearly every instance.

Failure of Job-Order Cost Method

As a means of eliminating preventable inefficiencies, the job-order cost method has been tragically inadequate; comparisons of the cost of a part manufactured this month with its cost last month and the month before may sometimes give information which will result in the elimination of an inefficiency, but rarely does the benefit approximate the effort. This post-mortem accounting has always reminded me of the oriental proverb "The mountain travailed and brought forth a mouse." Infinitely better results with far less effort can be obtained from the use of standard costs.

Considered from the standpoint of giving the sales department information which will enable it to adopt price policies to realize the maximum net profit under existing conditions, the job-order cost plan has also proved defective. The sales manager is called upon to submit a bid for several milling machines, we will say. He calls the cost accountant and asks him what these machines will cost. If the cost system being operated is a job-order cost system, and this particular type of machine has not been manufactured during the last six months, all the information the cost man can give him is what that particular machine cost to make six months ago, the cost figure representing a conglomeration of labor, material and burden rates extending probably over a period of months. Of course, if the cost accountant has any sense, he will realize the uselessness of this cost considered from the standpoint of today's needs, and in place thereof submit an estimate of the cost today. But in doing this he is abandoning the retrospective cost idea and instead is using standard costs in a crude way.

Cost of the Job-Order Cost System

Considered from the standpoint of its cost of operation, the retrospective or job-order cost system has been nothing less than an economic crime. It is not possible to make any accurate estimate of the appalling waste of human effort which should be charged to the account of the job-order cost method: the time of machine workers and clerks spent in figuring the time spent on individual operations; the elapsed-time clocks; the slowing down of production resulting from all this rigmarole, the extensions, postings to the detailed cost cards, totallings, figuring of the average costs by operations, comparisons with previous operation costs, investigations of increases over previous costs, generally resulting in the discovery that the wrong part number was entered on the time card or some similar mistake made—can anyone figure how much this roundabout method has cost the world?

A Dangerous Hybrid

The job-order cost plan, like other costly failures, is passing into the discard, and represents by no means a small item to the debit of the Cost of Progress account. I have rattled its old bones in this article because there has appeared in the land an even more dangerous creation, a hybrid of the job-order plan and the standard cost plan, which contains all of the defects of the job-order plan plus some more, and presents few of the good points of the standard cost plan. Under this so-called standard cost method job-order costs are still compiled, the detailed costs of operations so obtained then being compared with

[1] See MANAGEMENT AND ADMINISTRATION for October 1924, p. 361; November 1924, p. 491, and December 1924, p. 605.

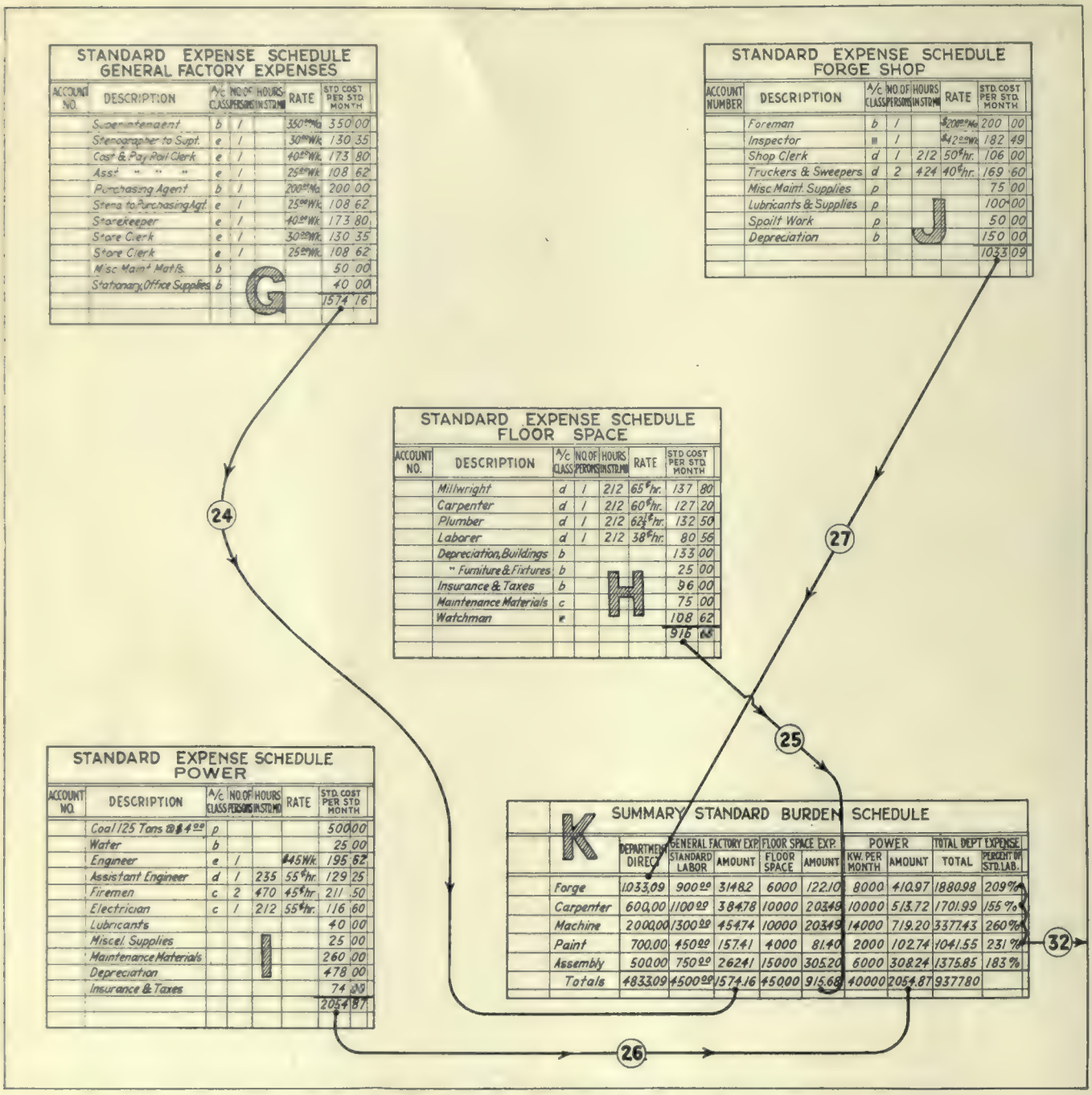


FIG. 10 FIGURING STANDARD BURDEN RATES

standards. In other words, standards are superimposed on the job-order cost system.

It is not possible within the limitations of this article to dwell at length on the defects of this plan. Suffice it to say that: (1) it adds additional expense to what was already prohibitive, (2) it does not give information regarding inefficiencies in such form and sufficiently promptly to aid properly in the elimination of such inefficiencies, and (3) it does not provide the means for figuring reproductive costs, namely the cost of manufacture under the conditions existing today.

Standard cost accounting represents the application of the *principle of exceptions* to cost accounting, and under this method, the nearer the factory to perfection, the less the cost accounting required. The ideal factory from a standard cost plan would be one where all producing operations were performed by piece work, and where all materials were issued according to specifications. In such a case there would be no accounting at all required for producing labor—piece work being standard. The cost work then would be practically confined to recording variations from standard prices of incoming materials, figuring the cost of spoiled work, and comparing the actual burden with standard.

Exceptions in labor costs generally represent inefficiencies, and it is these exceptions which interest the superintendent; if he takes care of the conditions which are exceptional, he can safely leave those which are normal or standard to take care of themselves.

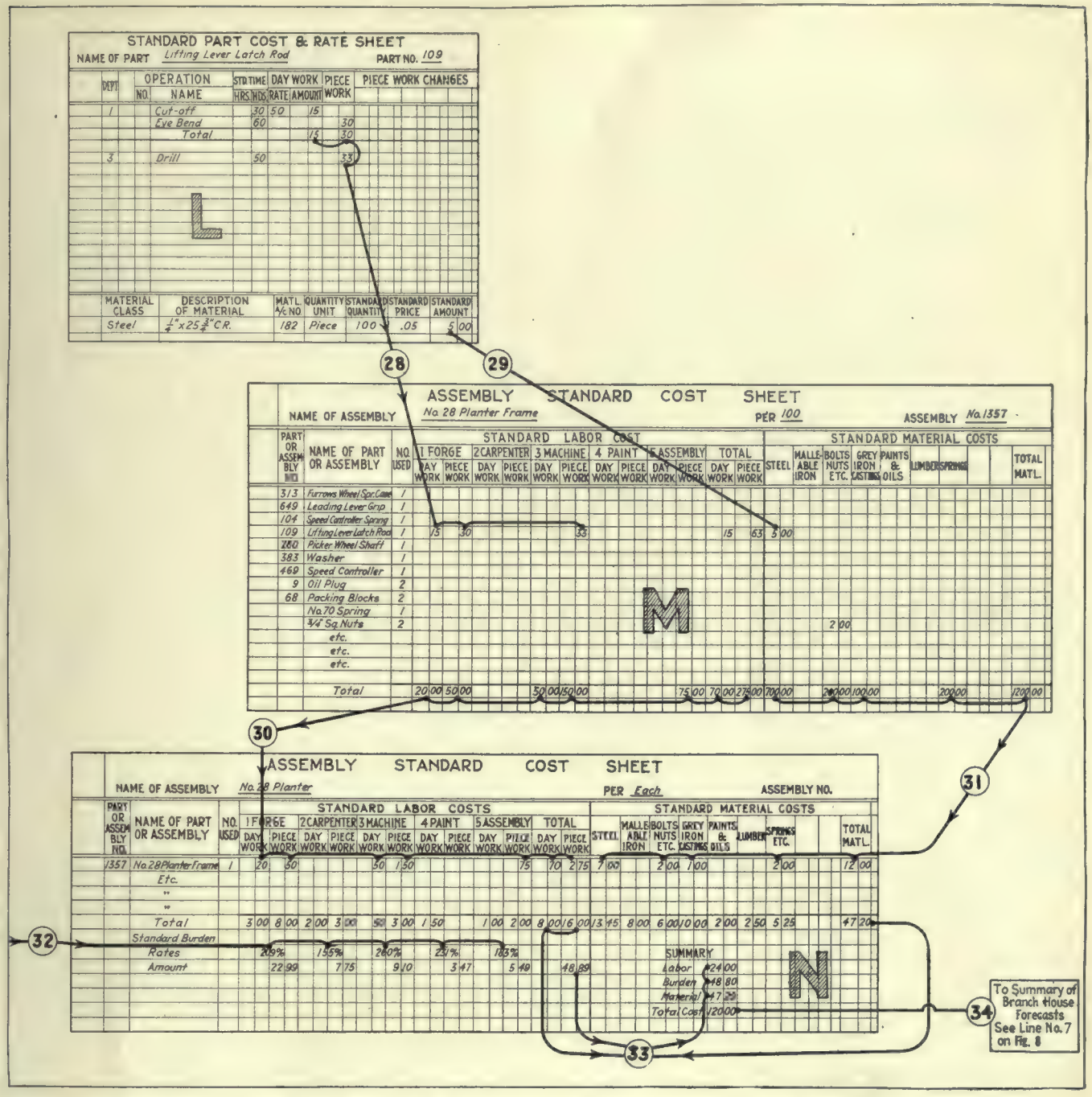

STANDARD PART COST & RATE SHEET
NAME OF PART Lifting Lever Latch Rod
PART NO. 109
ASSEMBLY STANDARD COST SHEET
NAME OF ASSEMBLY No. 28 Planter Frame
PER 100
ASSEMBLY No. 1357
ASSEMBLY STANDARD COST SHEET
NAME OF ASSEMBLY No. 28 Planter
PER Each
ASSEMBLY NO.
SUMMARY
To Summary of Branch House Forecasts See Line No. 7 on Fig. 8

FIG. 11 FIGURING STANDARD COST OF PARTS AND ASSEMBLIES

The more I apply standard costs, the more firmly convinced I am that the time element is of supreme importance in presenting information regarding inefficiencies. The value of information of this character tends to be in inverse ratio to the time which elapses between the event and the report. In most cases it is possible to present the superintendent today with complete information regarding yesterday's labor inefficiencies and to do this at relatively trifling expense. In a factory where the bulk of the work is done on a piece-work basis, the problem is essentially a simple one, because, as previously stated, piece work and standard are the same, so that no accounting work is required in connection with piece work except to compile it for pay-roll purposes. In those cases where a piece-work job for any reason is done day-work, it is necessary to figure the piece-work cost of the production and compare this with standard. Re-operation cost, that is, the cost of duplicating an operation, will be shown as an excess cost.

The bulk of the work is, therefore, confined to figuring standard hours represented by the production, and comparing these hours with the actual hours worked by the day-work producers. This method does not require the recording of the time spent on individual operations, but merely involves the comparison of the total time worked by the individual, as shown by the in-and-out clock, with the standard hours repre-

sented by the work he did. Under this plan we obtained the efficiency of the individual, of the department and of the factory as a whole.

Value of Daily Labor Efficiency Report

The moral effect of a daily labor efficiency report is what gives it potency. The foreman is given a standard schedule which states that under such and such conditions he is entitled to a certain organization: so many truckers, so many sweepers, so many set-up men. He also has standards for the production of work done on a day-work basis. Now, when the foreman knows that, if the standard schedule calls for 5 truckers and he uses 6 truckers, the superintendent is going to ask him tomorrow why he had an additional trucker, you may rest assured that he is going to keep his trucker force down to 5 or have some most excellent reason to advance for that extra man. And furthermore, if he knows that the superintendent knows each day what the efficiency of the day-work producers is, the foreman will not take long to weed the drones out of his force.

In a preceding article[2] in this series, I included two diagrams illustrating the method of forecasting the profits of a business. If reference is made to the first of these diagrams (Fig. 8, line 7), it will be noted that the gross profits on the forecasted sales of the branches were obtained by deducting the standard factory cost of the different items of product from the estimated sales value thereof. Figs. 10 and 11, appearing with this article, illustrate the method of figuring these standard costs. It is hardly necessary to state that all figures incorporated in these diagrams are hypothetical.

In a factory doing jobbing work, it is desirable that burden be distributed on a machine-rate basis, but in a factory turning out a standardized product, it is not generally necessary to introduce this added complexity to the cost accounting and, as will be noted by reference to Form K, the plan illustrated provides for the distribution of departmental burden on the basis of the standard producing labor. Should the reader, however, desire information as to the method of figuring standard burden costs on a machine-hour basis, he is referred to a previous series of articles by the writer.[3]

All standard burden costs are figured on the basis of the standard month, this representing 1/12 of the calendar year reduced to a working-hour basis. Obviously the number of working hours in the standard month varies with the locality (due to the number of public holidays recognized in the different states) and with the individual business (due to the difference in the number of hours worked by the different concerns), so that it is necessary for each business to figure its own standard month schedule. How this is accomplished is clearly illustrated in Table 5, where, in the case taken as an example, the total standard working hours in the year have been figured at 2544, representing a standard month of 212 working hours.

Standard Expense Schedule—General Factory Expenses (Form G). On this schedule are listed the expenses which cannot be charged directly to the producing departments (see Form J for the method of figuring direct departmental expenses) with the exception of power expense (see Form I) and expenses distributable on a floor-space basis (see Form H).

Attention is drawn to the column headed "Account Class" on all of the expense schedules illustrated on this diagram. One of the most important functions of a standard cost plan is to provide an analysis by causes of variations from standard costs, and it will be readily understood that different classes of expense vary as regards the different causes which will effect them. For instance, take the first item on Form G, that of the salary of the superintendent who is paid a monthly salary; if the plant closes down half the month his salary still continues, half of it being a charge to the Idle Time account. Compare this item with that of the truckers and sweepers in the forge shop (see Form J) who are only paid when the forge shop is working. When the plant is closed down their pay stops, and there is no charge to Idle Time. Under the writer's method of determining the causes of cost variations, as will be explained later in the series, a simple set of formulas is used, different formulas being used for the different classes of expense:

p—indicates an expense tending to vary directly with the production, as, for instance, the lubricants and supplies in the forge shop (see Form J).

b—indicates an expense which is in the nature of a fixed monthly charge, such as the salary of the superintendent (see Form G).

c—indicates an expense which is in the nature of a fixed charge per working day, as, for instance, the wages of the fireman (see Form I).

d—indicates an expense which is in the nature of a fixed charge per day worked, as, for instance, the shop clerk in the forge shop (see Form J).

e—indicates an expense which is in the nature of a fixed charge per week, as, for instance, the salary of the stenographer to the superintendent (see Form G).

The method of figuring the standard cost per standard month for these different classes of expense is clearly illustrated on the diagram. The superintendent's salary of $350 a month obviously represents a cost per standard month of this amount. In the case of employees paid on a weekly basis, the standard cost per standard month represents the weekly salary multiplied by the number of weeks in the standard month, which equals $\frac{365}{12 \times 7}$, or 4.345, so that the standard cost per month of $130.35 of the superintendent's stenographer is arrived at as follows:

$$\$30 \times 4.345 = \$130.35$$

The standard cost per standard month of wages coming under classes *c* or *d* is obtained by extending the estimated hours worked in the standard month

[2] See MANAGEMENT AND ADMINISTRATION for December 1924, p. 605.

[3] "Working Plans for Standard Costs," *Management Engineering*, June to December 1922, inclusive.

by the standard rate per hour—for instance, it is estimated that the assistant engineer will work 235 hours in the standard month, the standard cost per standard month for his services of $129.25 being made up by multiplying his standard hourly rate of 55 cents by 235.

The total standard cost of the general factory expenses of $1574.16 is carried from Form G to Form K (as illustrated by line 24) and is there distributed to the producing departments in proportion to their standard producing labor as shown on the diagram.

Standard Expense Schedule—Expenses Distributable on a Floor-Space Basis (Form H). On this schedule are listed those expenses which are most equitably distributed to the producing departments on the basis of their respective floor space. The total standard cost per standard month of these expenses of $915.68 is carried from Form H to Form K (as illustrated by line 25) and is there distributed to the producing departments in proportion to their respective areas, as illustrated on the diagram.

Standard Expense Schedule—Power (Form I). The total standard power expense per standard month of $2054.87 is carried from Form I to Form K (as illustrated by line 26) and is there distributed to the producing departments in proportion to their estimated power consumption expressed in kw-hr., as shown on the diagram.

Standard Expense Schedule—Forge Shop (Form J). On this schedule are listed the expenses which are directly chargeable to the forge shop. The total of these of $1033.09 is carried from Form J to Form K as illustrated by line 27.

Summary Standard Burden Schedule (Form K). On this form the standard expenses chargeable to the various producing departments are accumulated, and the cost per dollar of standard producing labor obtained. It is assumed that the standard producing labor of the forge shop per standard month is $900, the standard burden chargeable to this department of $1880.98 being made up as follows:

Direct Departmental Expense per Form J	$1033.09
General Factory Expense per Form G	314.82
Floor Space Expense per Form H	122.10
Power Expense per Form I	410.97
Total	$1880.98

Dividing this amount of $1880.98 by the standard producing labor of $900 gives a standard burden rate for this department of 209 per cent. This rate is used in figuring the standard burden cost of the product as illustrated by line 32.

Standard Part Cost and Rate Sheet (Form L). This form serves the dual purpose of a standard cost sheet and a piece-work rate sheet. The standard cost of a day-work operation is obtained by extending the standard time at the standard rate per hour. The standard material cost is obtained by extending the standard quantity of material required at the standard price of the material. Standard material should represent the market prices of the various items of raw materials at substantially the same date. The method usually followed is to take as standard the prices of the inventory at the commencement of the year in which the installation of the cost system is made. If any item is figured in the inventory at a price entirely out of line with the market price at that date, this price should not be used as standard, but the market price should be used instead. All standard prices should be figured on an F. O. B. factory basis.

Assembly Standard Cost Sheet (Form M). On this form is illustrated the method of compiling the cost of a planter frame, this forming part of the complete planter, the standard cost of which is figured on Form N. Line 28 illustrates the posting of the standard cost of part number 109 from Form L to Form M, this standard cost being analyzed by producing departments for labor (showing these labor costs divided as between day work and piece work) and by material classes for material.

Assembly Standard Cost Sheet for Complete Machine (Form N). The total standard costs of the different sub-assemblies entering into the complete machine assembly are posted from the assembly standard cost sheets for such assemblies as illustrated by lines 30 and 31. The standard cost of parts entering into the main assembly and not forming part of the sub-assemblies would be posted to Form N direct from the standard part cost and rate sheets for such parts.

The standard burden costs of parts and part-assemblies is not figured, burden rates being applied only to the complete machine cost as illustrated by line 32. The total standard cost of the machine is used in figuring the estimated gross profits on the summary of branch house forecasts, line 34 on Fig. 11 and line 7 on Fig. 8.

(To be continued in the February issue)

TABLE 5. STANDARD WORKING HOURS IN WORKING MONTH

Month	Days in Month	Hours in Month on 9-Hour Basis	Deductions							Working Hours in Month
			Sundays		Saturdays		Holidays			
			No. in Month	Hours on 9-Hour Basis	No. in Month	Hours on 4-Hour Basis	Name	Hours on 9-Hour Basis	Total Deduction in Hours	
Jan.	31	279	5	45	4	16	New Year	9	70	209
Feb.	28	252	4	36	4	16			52	200
March	31	279	4	36	4	16			52	227
April	30	270	5	45	5	20			65	205
May	31	279	4	36	4	16	Memorial Day	9	61	218
June	30	270	4	36	4	16			52	218
July	31	279	5	45	5	20	Independence Day	9	74	205
Aug.	31	279	4	36	4	16			52	227
Sept.	30	270	4	36	5	20	Labor Day	9	65	205
Oct.	31	279	5	45	4	16			61	218
Nov.	30	270	4	36	4	16	Thanksgiving	9	61	209
Dec.	31	279	5	45	5	20	Christmas	9	74	205
Total	365	3285	53	477	52	208		54	739	2546

Allow for Misc. Elections, Etc.	2
Total Working Hours in Year	2544
Total Working Hours in Month	212

Low Body Auto Truck for Handling Material

THE accompanying photographs show a MacDonald gasoline-driven motor truck, made in 6- and 10-ton sizes, that marks a departure from conventionalities. One of its most interesting and important features is an unusually low body. The bed is only 18 in.

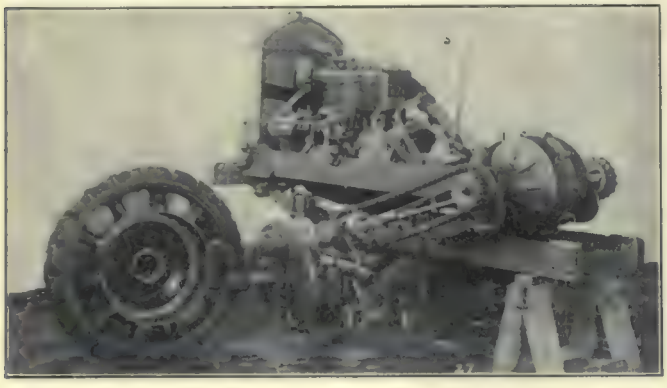


FIG. 1 ENGINE SUPPORT AND FRONT WHEEL DRIVE

from the ground and hence the truck can be loaded from the curb. This low bed is made possible by the arrangement of engine suspension and by substituting a front-wheel drive for the customary rear-wheel drive.

Fig. 1 shows these features. Springs beneath the engine absorb all shocks, add to the life of the truck, and reduce repair bills. The front-wheel drive relieves the rear wheels of some of their work, and doubles the life of the rear load-carrying tires.

The main body of the truck is mounted on three supporting points—the two rear wheels and the front frame. This arrangement eliminates all frame distortion or weaving, which is one of the most destructive forces acting in a motor vehicle. In Fig. 2 a truck is shown with one of its rear wheels run up on the sidewalk. The three-point support prevents undue strain on the framework in such a position.

The steering mechanism acts through a simple hydraulic control, a cylinder being attached to the right side of the truck in front of the front wheels. The driver can throw the wheels of a loaded truck from extreme to extreme, while the vehicle is standing still, with little physical effort. Hence the truck can be placed advantageously for loading and unloading.

The use of removable staves in the side of the truck

FIG. 2 STRAIN ON BODY REDUCED BY 3-POINT SUPPORT

enables it to be loaded from the side as well as from the back. The greater width of this side opening, coupled with the low body design, is a decided advantage in handling bulky crates or boxes.

Fig. 3 shows one of these trucks carrying a load and, in addition, pulling a loaded dray also constructed with a low body, and open all around.

FIG. 3 LOW BODY FRONT-WHEEL DRIVE TRUCK CARRYING LOAD AND PULLING TRAILER

Cutting Down Shipping Losses

Safe and Low-Cost Delivery of Manufactured Products Is the Main Essential

By H. H. SQUIRE

Sales Promotion Manager, The Hinde and Dauch Paper Company

WHEN the subject of shipping containers is discussed, very often their outward and visible aspects are stressed almost to the exclusion of the economic phases of the question. Even the trained technical man, in specifying materials and construction for packing containers, often falls into the error of calling for methods which increase final distribution costs in order to effect some minor saving to the carrier.

From his point of view, a broken or damaged container among a thousand sound ones is irrefutable evidence of a weakness which must be corrected at any cost, and too often he prescribes remedies which involve expense far exceeding any possible benefit to be derived from their adoption.

Whenever the relative merits of shipping packages are considered, the first thought is usually a comparison between wooden boxes and those made of fiber. Statistical comparisons of performance are frequently made from information gathered by able experts. Often, however, these comparisons are lacking in two particulars, both of which are essential to any fair consideration of the matter.

In the first place, as a rule, no distinction is made between plain and corrugated fiber boxes, although each is specially adaptable in widely differing fields. In the second place, all data and deductions usually have reference to the apparent condition of the *container* at the time of observation, while, at the best, but slight attention is given to the actual condition of the contents.

Where there is smoke there is probably fire. Likewise, bruised and broken boxes may well suggest damaged goods. But, to follow the analogy, it is the fire and not the smoke upon which the hose should be turned. The actual damage or breakage to the contents of a package is the important consideration, not the mere condition of the package itself upon its arrival at its destination.

Shipping boxes in service are not the articles of merchandise for whose safety in transit the carrier is held responsible. Protection of their contents from loss and injury constitutes the sole warrant for the existence of containers. Whether or not they perform that function is the matter of prime importance to shipper, carrier, and receiver alike.

In this article it would be neither ethical nor at all in point to make a comparison between the different kinds of containers. Each has its special field. Each variety can be so constructed that it will perform its work in that field with the highest degree of satisfaction and, at the same time, so that packing and shipping costs will be conserved. The crate, the wirebound box, the plain fiber container, and the corrugated package rarely enter into proper *economic* competition with each other.

Speaking for the corrugated box, it is not claimed that it possesses the impenetrability of wood, nor the rigidity of that material at points of contact. Yet its very lack of these qualities enables the corrugated container to sustain crushing blows and disfiguring abrasions, and at the same time to protect its contents by means of the cushioning effect achieved through its construction. Where more rigid and unyielding containers have allowed their contents to be smashed, while they themselves stood up solidly in spite of rough handling in shipment, the corrugated container, by means of its resilience, has absorbed the shocks and blows and left its contents unscathed. Where a more rigid container has split and shattered in transit, with consequent breakage of the articles it held, the fiber container, by reason of its toughness and elasticity, has yielded to the damaging force in a way to prevent injury to the articles it carried.

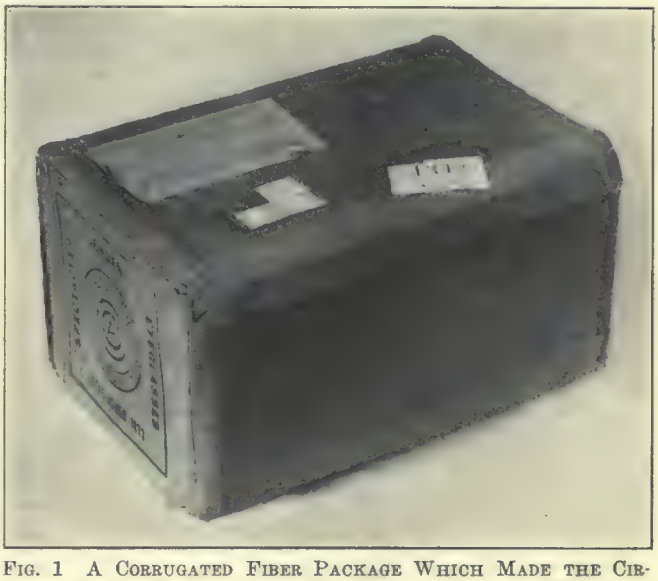


FIG. 1 A CORRUGATED FIBER PACKAGE WHICH MADE THE CIRCUIT OF THE ENTIRE GLOBE AND RETURNED TO THE SHIPPER

A great volume of specific evidence is on record to substantiate the above statements. The records of the once famous Pridham case, in the determination of which the Interstate Commerce Commission some years ago established the present equality of freight rates between fiber-packed and wood-boxed shipments, contain hundreds of pages of testimony proving the large

savings of merchandise from breakage and damage in transit, which have resulted from the use of the corrugated box. The present article supplies much additional data along the same lines from individual manufacturing plants.

Let me reiterate the fundamental principle that shipping boxes are not bought and used for their own self-preservation. Fig. 1 shows a corrugated fiber package which, loaded with optical goods, made the

FIG. 2 CORRUGATED SHIPPING BOX FOR ELECTRIC SUCTION CLEANERS

circuit of the entire globe via the Mediterranean, Melbourne, Honolulu, San Francisco, and back to the shipper, The American Optical Company, at Southbridge, Massachusetts, with contents intact. The battered corners and punctured outer surface of this container evidence the rough handling naturally incident to such a journey. If the oft-suggested technical standards of unyielding rigidity and impenetrability had been enforced in designing a package for this purpose, it is doubtful whether the box would have survived the journey, and it is almost certain that some of the contents would have been damaged.

While this does not prove the adaptability of the corrugated package to every packing requirement, it does show conclusively that there are commodities and products for which this type of box excels all other shipping containers. Just what and how many these commodities are is a question which is being daily worked out scientifically for the products of an increasingly large number of manufacturers. Where tests and investigations prove the corrugated container to be the best for the purpose, it not only saves large sums of money by reducing damage to products in transit, but also adds still further to these savings by its much lower original cost, its convenience in the packing room, its light shipping weight and its compactness in storage.

The widest single field in which the corrugated package has fully demonstrated its worth is in the packing of glassware and products put up in glass containers, and in corresponding uses for all manner of fragile goods of moderate weight. In conjunction with internal partitions of corrugated fiber, it has brought savings of large proportions to many manufacturers.

Partitions divide the interior of the box into cells, providing separate cushioned compartments for each individual unit of contents. These partitions are formed by slotting both the lengthwise and crosswise pieces half way down and then meshing them together. Two or more tiers in the same box are separated by flat sheets or pads of corrugated board, and the box is often lined with similar material to augment its natural resilience.

Other protective devices which may be substituted for the corrugated paper partitions are also made from the same material. These include wrappers and cartons of varied construction, designed to eliminate contact of articles and shock suffered by the outside walls. Thus, electric bulbs are often encased in special wrappers. Manufacturers of ink frequently wrap filled bottles of the larger sizes in smooth-backed corrugated sheets. The panel bottles used in the medicine trade are usually protected by complete corrugation-lined cartons on which trade-marks, formulas, etc.,

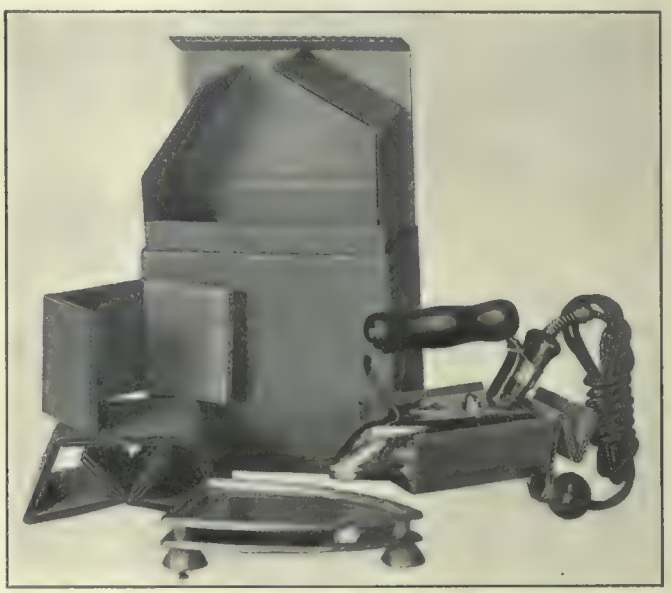


FIG. 3 CORRUGATED SHIPPING BOX USED TO SHIP WESTINGHOUSE ELECTRIC PRODUCTS COMPANY IRONS

are printed. In addition, these wrappers and cartons are not infrequently supplemented with partitions whose cells contain from one to six each of the wrapped units.

Some commodities are staunch enough in themselves to withstand almost any hard knock received in shipment. But often such articles are finished with a surface which must be protected. Commodities of this class sometimes require boxes of extra thickness and strength. These are made from two thicknesses of double-faced board, or from the so-called double-double-faced board, which consists of two corrugated

sheets joined to one middle and two outside flat sheets of facing or liner board. Still other commodities, whether in single or double boxes, must be cushioned or braced within the container by corrugated sheets of special design, so cut and scored as to suspend the article or articles and to absorb all shocks.

An example of this latter type is found in another product of the glass industry, namely, illuminating glassware. Articles of this kind require the most careful packing.

The Phoenix Glass Company in 1923 shipped nearly 1,000,000 pieces of glassware with practically no breakage. Previous to using corrugated fiber boxes, breakage was a considerable item. In fact, one style of dining-room globe made by the Phoenix Company could not be shipped because its percentage of breakage was so high. Now 500 of these globes a month safely arrive at their destination. In practically all cases of breakage experienced by this company since it has used corrugated containers, the railroad admits its responsibility and pays the claims.

Previously, the goods were shipped in barrels and boxes, but though they were packed by experienced packers, the breakage was always high. The corrugated containers have been so designed that inexperienced girls can pack them, as there is but one way to insert the contents. When using barrels, this company shipped three of its commercial lighting units in each container and the distributor had to unpack them for reshipment. Now each is packed separately and the distributor merely relabels each corrugated box and sends it on. About 350,000 of these particular units are sold each year. Hence, the saving both to manufacturer and distributor is considerable when all factors are considered.

Other advantages accruing are the shipment of 1650 commercial fixtures per railroad car as against 750 previously, with the total weight per car reduced by 2000 lb. Altogether, between 30 and 35 per cent of freightage has been saved because of the reduction of space and weight.

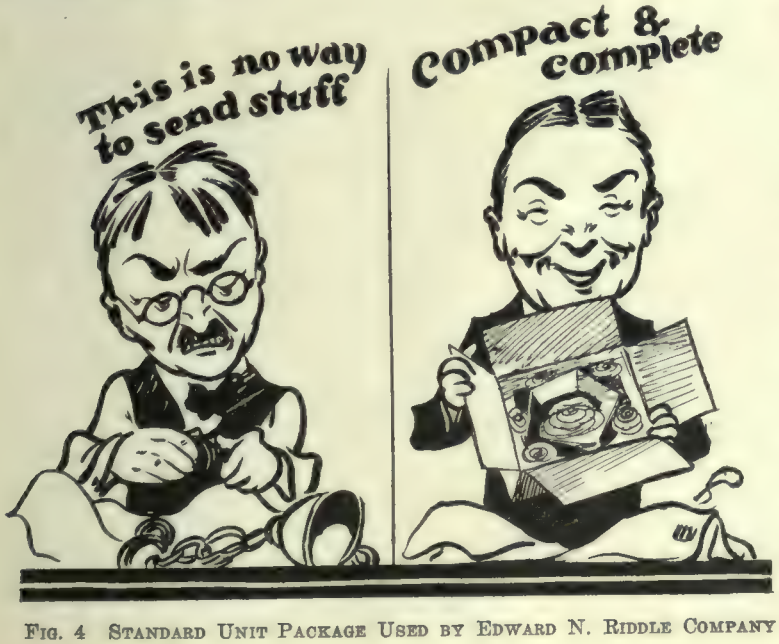


FIG. 4 STANDARD UNIT PACKAGE USED BY EDWARD N. RIDDLE COMPANY

Foreign shipments are now possible where formerly they were most discouraging. In 1923, 2000 globes were sent to Johannesburg, South Africa, and but two were broken. In a certain test made by one of this same company's important customers, with 2500 pieces of one of the most fragile patterns shipped in unit packages all over the United States, but nine pieces were broken in transit. Internal stays and braces, made of corrugated fiber board and so placed as to suspend the contents of the package entirely clear of the box walls, were the primary cause of this remarkably good record.

A few months ago the Gleason-Tiebout Glass Company of Brooklyn, New York, made a special test of this same packing system by shipping 425 uncrated corrugated boxes filled with illuminating glassware, 5298 miles by water to San Francisco, California. Of the entire lot, only three pieces were broken when the shipment was delivered to the consignee.

In a published statement, this big concern comments enthusiastically upon the saving of breakage, shipping weight, storage space and labor of packing, effected by the use of this packaging method. The advantage to the distributor is equally important, in the saving of floor space, the elimination of inflammable litter and the ability to locate breakage and check invoices and inventories without unpacking the goods.

This same packing method is used to excellent advantage in the packaging of many commodities not strictly fragile. Mechanical appliances, apparatus, and parts, of irregular shape, usually have protruding portions which are liable to be broken off in transit or may puncture their own containers and damage other freight loaded in the same car. Such articles are carried in corrugated boxes with internal braces fitted so that the entire weight rests on non-breakable surfaces. All fragile and projecting parts are completely suspended and do not come in contact with the walls of the container, or even with the cushioned surfaces of the supporting pieces.

That there are other than mere physical advantages to be had from this style of packaging is well known among shippers of electrical appliances, and is brought out in the statement of the Apex Electrical Manufacturing Company of Cleveland, Ohio, from which we quote a little further on.

This concern ships its electrical suction cleaners, assembled and adjusted, in specially constructed, handsomely printed corrugated fiber shipping boxes, Fig. 2, and after recounting the savings in money and labor thus effected for both manufacturer and dealer, has this to say:

> Then, too, these Apex Cleaner boxes are used by our dealers to decorate windows, and, with the cleaners, make a fine window display. Also retail salesmen, in carrying cleaners in these boxes, obtain a lot of free advertising.

This added advantage is of great importance, for it facilitates consumer acceptance,

which is directly reflected in the increase of sales.

By this suspension method of packing, articles are carried safely, and, incidentally, economies of weight and volume of containers are brought about which run up into large savings annually.

For instance, an electric iron manufactured by the Westinghouse Electric Products Company and weighing 4¾ lb. is packed, with all its parts complete, in a corrugated box which, with its bracing members, weighs 3 lb. 12 oz., while the wooden box formerly used, with its excelsior stuffing, weighed 12 lb. 3 oz. Thus the filled wooden box weighed 17 lb., or just twice the combined weight of corrugated box and iron. This sort of package, complete, is shown in Fig. 3.

The same suspension principle is widely used in packing machines and appliances formerly shipped knocked down or only partly assembled. Many of these are now packed completely set up and adjusted for immediate use. This is accomplished by so bracing them in corrugated boxes that no weight rests upon any breakable part. By the use of these unit packages, the manufacturer saves his customer the trouble and annoyance of assembling complicated appliances, and still keeps his package size and weight within limits.

Both the jobber and the dealer, as already suggested, are sharers in still further benefits had from this unit packaging plan. They are enabled to verify invoices by a mere count of standard packages, to keep stock in an orderly and readily inventoried form, and to handle, reship and deliver their wares in original packages, without any of the trouble, litter and breakage incident to unpacking and handling.

Distributors of electrical appliances are perhaps foremost in appreciation of the corrugated unit package. They are so thoroughly educated to its advantages that they practically demand it. There are, however, many far-seeing manufacturers of other lines, who are keenly alive to the value of the dealer satisfaction and co-operation which may be stimulated in their own packing rooms.

A case in point is that of the Edward N. Riddle Company of Toledo, Ohio, manufacturers of lighting "Fitments," one of whose many standard unit packages is shown in Fig. 4. This box contains a 5-light chandelier with all parts assembled and ready for hanging. The convenience to the distributing house and the retail dealer is obvious and, as may be inferred from the accompanying cartoon which we reprint from their house organ, the manufacturers accord a large measure of credit for the popularity of their product to the package in which it is shipped.

But in summing up the advantages to be had from the corrugated fiber package, the consideration of safety is the factor of prime importance—not indestructibility of the container itself (although, even in this, it presents an enviable record), but security and protection of the products of industry on their journey from maker to user. Here, its superiority in the many fields of its usefulness is attested to by its ever-widening circle of application.

Demonstrating Machinery Under Power

ALL men who have anything to do with the purchase or use of equipment like to know what is available on the market, and what developments are taking place in the particular lines of manufacturing apparatus which they use. They like to see, in physical form and under actual running conditions, the machinery to which their attention may have been directed by advertising, and of which they are prospective purchasers.

But shows cannot be held continuously nor do they reach men in all the places where power and machine tool appliance makers are anxious to demonstrate the advantages of their products.

To give customers the opportunity of actually seeing such equipment at work, and to help increase sales, many manufacturers and sales organizations have established exhibition rooms where machinery can be effectively displayed and demonstrated under power. One of these salesrooms, that of the Harron, Rickard and McCone Company, is shown in Fig. 1. The machines are driven by belts from a special line shaft installed under the ceiling of the salesroom. Each machine is bolted to an individual wooden base, which, in turn, rests on the floor of the salesroom, forming a reasonably steady foundation.

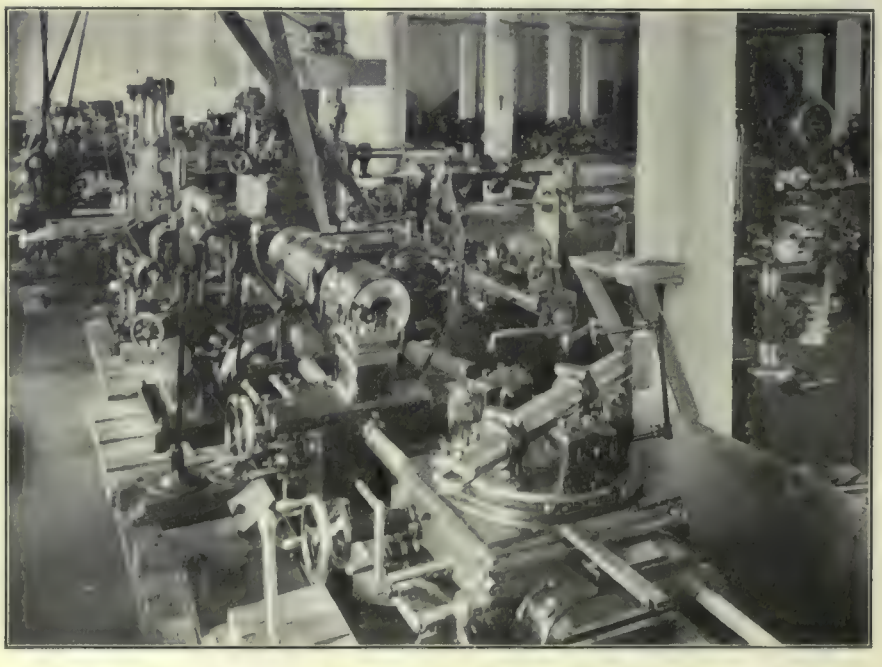


FIG. 1 MACHINE TOOLS DEMONSTRATED UNDER POWER IN SALESROOM

Savings in Material Handling

Experience Data on Conveyor Systems and Coal Equipment

By GEORGE E. HAGEMANN

Associate Editor, MANAGEMENT AND ADMINISTRATION

THE subject of material handling is one which is receiving constantly increasing attention. From the standpoint of necessity—on account of actual labor shortage—and from that of economy—to simplify operations, cut down costs, and add to profits—the question of improving handling methods in the individual plant, whatever its nature and its product, is one that is well worth any time and trouble spent in its solution. It is a rare case which, after investigation, shows no possibility of further savings, if hand labor or intricate routine are discovered to any extent under present methods.

The present article is in no sense a comparison of one type or make of equipment against another, nor must it be construed as a presentation of the only savings which have been accomplished in handling methods in manufacturing plants. Many makers of such equipment whose products are not contained in this compilation have done remarkable work in bringing about savings in American industries, from the smallest to the largest. The concerns for whom these gratifying results were accomplished have, in many cases, been unwilling to have either their names or the facts made public. In other cases, records of former methods have been so meager that comparisons bringing out the savings produced have not been possible with any degree of accuracy.

However, the partial presentation given in this article, which will be continued in a succeeding issue, demonstrates clearly that substantial economies are possible and provable. The present article gives illustrations which have been gathered on conveyors and coal handling equipment.[1]

In the plant of The Tin Decorating Company, of Baltimore, Mathews carriers have been instrumental in bringing about large annual savings. Interior transportation costs are a large item of expense in this plant, hence, in April, 1923, there were installed systems consisting of three elevating conveyors for lifting empty cases from the first to the second and third floors, and three spiral gravity roller conveyors for lowering filled cases from the second and third floors to the first floor.

The conveyors run up through what was originally a court in the center of the building. Seventeen thousand cases per 9 hr. day is the ultimate capacity of the system. At present an average of about 2,000 per day is handled. The filled cases average from 75 to 100 lb. apiece, and some of them weigh as much as 200 lb.

Formerly hand trucks were employed which traveled between floors on three elevators. The truckers often had to go the entire length of the building to reach the elevators and frequently had to wait for elevator service. Now, however, there is neither travel nor delay, and 40 men have been released for productive work at a saving of $43,200 per yr. in wages.

Doing away with 700 hand trucks, occupying 20 sq. ft. each, has netted the company, after deducting the area occupied by the present system, 7000 sq. ft. of useful floor space which was badly needed. A further saving of space and handling is to be made by installing an addition to the gravity conveyor system to take it back between the packing tables. This could not be done originally because it would have interfered at the time with production.

TABLE 1. MATHEWS CONVEYOR DATA
The Tin Decorating Company of Baltimore

OPERATING COST OF 3 ELEVATING AND CONVEYING SYSTEMS	
Depreciation—$7,600 ÷ 15 yrs. of life	$506.67
[1] Average interest at 6 per cent— $\frac{16}{15} \times \frac{\$7{,}600 \times 0.06}{2}$	243.20
Repairs and maintenance, estimated	250.00
Power—4,800 kw. hr. @ $0.035	168.00
Total cost per year	$1,167.87
Cost per day—$1,167.87 ÷ 300 days	$3.89
Cost per 100 cases—$3.89 ÷ 4,000 cases × 100	0.097
Cost per ton—$3.89 ÷ 75 tons	0.052
SAVINGS DUE TO 3 ELEVATING AND CONVEYING SYSTEMS	
Wages of 40 hand truckers—40 × $3.60 per day × 300 days	$43,200.00
Floor space—formerly 700 trucks @ 20 sq. ft. = 14,000 sq. ft. Now used for cases 7,000 sq. ft. Net saving 7,000 sq. ft. @ $0.60	4,200.00
Total saving per year	$47,400.00
Annual return on the investment	624%
SAVINGS DUE TO BELT CONVEYOR, HANDLING CARTONS	
Cost per car loaded—hand trucks—8 men × 4 hr. × $0.40	$12.80
Cost per car loaded—Mathews Conveyor—3 men × ½ hr. × $0.40	0.60
Saving per car	$12.20
Saving per year—150 cars @ $12.20	$1,830.00

[1] Allowing for interest earned by depreciation reserve.

From the third floor of the plant a Mathews belt conveyor 150 ft. long carries filled cartons to the gravity conveyor. Through this medium a freight car can be loaded in only 13 minutes. Table 1 shows the details of the total annual savings, which amount to $47,400.

In the Yonkers Plant of the National Sugar Refining Company, Mathews Gravity Conveyors have effected an annual saving of $8,803. This system was installed in 1921.

One and two lb. packages of sugar are placed in shipping cartons on the third floor of the carton depart-

[1] Reports on Mathews and Weller equipment compiled and prepared by A. C. Nielsen Company.

TABLE 2. MATHEWS CONVEYOR DATA
Yonkers Refinery, National Sugar Refining Company

COST OF TRANSFERRING SUGAR PACKAGES WITH CONVEYOR	
Depreciation—$2,981 ÷ 20 yr. of life	$149.05
Average interest at 6 per cent— $\frac{21}{20} \times \frac{\$2.981 \times 0.06}{2}$	93.90
Maintenance	60.00
Repairs	15.00
Total annual fixed costs	$317.95
Fixed cost per working day—$317.95 ÷ 306	$1.04
Fixed cost per shift—$1.04 ÷ 3	$0.35
Labor—Feeding conveyor—⅓ time of boy × $3.00	1.50
Loading trucks—1 man × $4.00	4.00
Total operating cost per shift	$5.85
Average cost per carton—$5.85 ÷ 3,500	$0.0017
SAVINGS EFFECTED BY USE OF CONVEYORS	
Cost of installing and using freight elevators (approximately):	
Depreciation—$6,500.00 ÷ 15 years	$433.33
[1] Average interest at 6 per cent— $\frac{16}{15} \times \frac{\$6,500 \times 0.06}{2}$	208.00
Maintenance and repairs	195.00
Total annual fixed costs	$836.33
Total annual fixed costs of Mathews conveyor	317.95
Saving in fixed cost per year	$518.38
Saving in labor—Elevator operator, Trucker } × 3 shifts	7,344.00
Saving in power costs—14,688 kw. hr. × $0.03	440.64
Total saving per year	$8,303.02
This saving paid for the conveyor in about 4 months of full operation.	

[1] Allowing for interest earned by depreciation reserve.

TABLE 3. MATHEWS CONVEYOR DATA
The Beacon Falls Rubber Shoe Co.

COST OF OPERATION—CONVEYING SYSTEM	
Depreciation—$4,589.80 ÷ 25 yr. of life	$183.59
[1] Average interest at 6 per cent— $\frac{26}{25} \times \frac{\$4,589.80 \times 0.06}{2}$	143.20
Maintenance and repairs	15.00
Power	10.00
Total per year	$351.79
Cost per day—$351.79 ÷ 280	$1.26
SAVINGS EFFECTED BY CONVEYING SYSTEM	
Time of at least 3½ men	$4,550.00
Additional space required—800 sq. ft. × $0.40	320.00
Total per year	$4,870.00
Cost of operation	351.79
Total net saving per year	$4,518.21
This saving pays for the conveyor in about one year.	

[1] Allowing for interest earned by depreciation reserve.

ment. The cartons measure about 16 x 20 x 14 in. and weigh about 55 lb. apiece. After sealing they are transferred to the ground 50 yards away by the conveyor, and are unloaded directly on electric industrial trucks. In passing down to the ground floor the cartons are carried outside of the building, where the spiral conveyor is located, and are delivered to a standard roller section extending around the corner of the building and running for more than 100 ft. along an alley-way. The end of this conveyor where the trucks are loaded is just high enough to permit running the trucks underneath so that one man can do the loading. The actual capacity of the system is more than 3500 cartons per 8 hr. shift. An elevator operator and at least one trucker have been released for productive work by the system. Table 2 shows the complete data.

Mathews conveyors installed in the plant of the Beacon Falls Rubber Shoe Company, at Beacon Falls, have been in use since about 1912 for conveying packed boxes from the storehouses and packing rooms to the shipping platform. The system consists of gravity roller sections, chutes, and two belt boosters.

These boxes, both of wood and of paper, and weighing from 20 to 90 lb. apiece, are taken from second, third, and fourth floors to the shipping platform on the ground floor. The system is an interconnecting one. While some of the shipments are made direct from the production department, most of them are sent from the storehouse.

As orders are made up of varying sizes and styles of products, a trucking system formerly in use was very unsatisfactory from the standpoint of time consumed in making up orders, delay, number of operators required, and floor space occupied. For some of these savings no attempt has been made to assign a dollars and cents value, but Table 3 supplies data showing the economies which have been distinctly demonstrated. The equipment, as is characteristic of conveyor systems in general, has required very little repair, in this case practically none in 12 years.

Equipment manufactured by The Standard Conveyor Company has produced in three cases the savings shown in Tables 4, 5 and 6. The installations cover the plants of the Nash Motor Company at Kenosha, The Frankling Co-operative Creamery Company, Minneapolis, and the W. F. Hall Printing Company, Chicago. These installations, representing annual savings, respectively, of $8602, $4053 and $1639, it will be noted are in lines totally different both from

TABLE 4. STANDARD CONVEYOR DATA
Nash Motor Company, Kenosha

EQUIPMENT	A Standard straight lift elevator, some gravity roller and a spiral chute constitute the unit of conveying equipment used in handling cylinder blocks in the Nash Plant. Cost of installation, $4,285.
PREVIOUS METHODS	Before the installation of conveying equipment the Nash Company used an industrial truck and manual labor.
COMPARATIVE LABOR COST	Without equipment 3 men were required at $4.50 a day—300 days per year. With equipment 1 man is required at $4.50 a day—300 days a year.
COMPARATIVE HANDLING TIME	Before equipment was installed 7,200 hr. were necessary to handle 72,000 cars a year. Since equipment was installed only 2400 hr. are necessary to handle the same volume.
SAVINGS IN LABOR	The savings in man-hours of labor yearly averages about 4,800.
SAVINGS IN FIXED CHARGES	Industrial truck including maintenance and interest, $995.
SAVINGS IN PRODUCTION	$2807.30 equals net savings per year through increased production.
TOTAL ANNUAL SAVINGS	Labor $4,800.00 Fixed charges 995.00 Increased production 2,807.30 Total annual savings $8,602.30

TABLE 5. STANDARD CONVEYOR DATA
Frankling Co-operative Creamery Company, Minneapolis

EQUIPMENT	Standard roller conveyors and inclined elevator, costing $6,123.
PREVIOUS METHODS	Trucks and manual labor were used to handle their equipment before conveyors were installed.
COMPARATIVE LABOR COSTS	Before the installation of conveying equipment 3 men were required at $30 per week or $4,680 a year. After the installation only 1 man was required on the same basis.
SAVINGS IN FIXED CHARGES	Annual savings on trucks and manual handling equipment, $950.
TOTAL SAVINGS	Forty-five-hundredths of a cent is saved on each of 900,000 cases handled in one year. By the old way, the handling of a case of milk cost 62-hundredths of a cent—by the new way only 17-hundredths of a cent.
	The total cost per year without equipment was... $5,630 The present total cost is... 1,577 Savings per year with equipment... $4,053

TABLE 6. STANDARD CONVEYOR DATA
W. F. Hall Printing Company, Chicago

EQUIPMENT	Six-story spiral chute connecting all floors with the shipping department. Total cost of installation, $2,569.35
PREVIOUS METHODS	Manual labor.
COMPARATIVE LABOR COSTS	Under old methods 6 men were required to handle 12,000 tons of printed matter a year at a cost of 33¾ cents a ton.
	Under new methods 3 men handle the same volume at a cost of 16⅞ cents per ton.
COMPARATIVE HANDLING TIME	The hours required to handle a definite quantity under old methods would average about 14,400 yearly.
	The hours required to handle a definite quantity under new methods would average about 7200 yearly.
SAVINGS IN LABOR	The savings in man-hours of labor yearly averages about 7,200.
TOTAL ANNUAL SAVINGS	Total labor cost per year handling the old way $4,050.00
	Total labor cost per year handling the new way 2,025.00
	Total gross savings in labor per year $2,025.00
	Depreciation 10 per cent of investment Interest 5 per cent of investment 385.40
	Total net savings $1,639.60
	Therefore, labor costs have been cut 50 per cent and total costs 40 per cent.

TABLE 7. WELLER CONVEYOR DATA
Bisbee Linseed Co.

OPERATING COST OF CONVEYING AND ELEVATING SYSTEM USED WITH GRAIN STORAGE TANK	
Depreciation—$13,500 ÷ 15 yr. of life	$900.00
[1] Average interest at 6 per cent—$\frac{16}{15} \times \frac{\$13,500 \times 0.06}{2}$	432.00
Maintenance and repairs (approximately)	340.00
Fixed cost per year	$1,672.00
Fixed cost per day—$1672 ÷ 280 days	$5.97
Power cost for transferring grain from storage tank to mill—average per 8 hr. day—260 kw. hr. @ $0.03	7.80
Power cost for operating conveying system from dock into tank—average *per hr.*—90 kw. hr. @ $0.03	2.70
SAVING EFFECTED BY SYSTEM	
Saving in labor, per year	$15,000.00
Annual return on the investment	111 per cent

[1] Allowing for interest earned by depreciation reserve.

each other and from the other conveyor systems mentioned in the present article. However, they represent only a small fraction of the number of plants and of the widely different kinds of industries in which conveyor systems have accomplished remarkable savings and greatly simplified production and handling operation.

At the plant of the Commonwealth Steel Company, Granite City, Peck carriers manufactured by the Link Belt Company are used to handle sand. About 10 years ago the first installation was made for the purpose of conveying core sand to the coremakers' benches. This unit is approximately 350 ft. long. In 1918 another unit approximately 550 ft. long was installed for facing sand. Recently, a third conveyor, 350 ft. long, for core sand, has been installed, and a fourth is contemplated for facing sand.

The return line of a conveyor system for molding sand picks up the sand dumped through gratings when the flasks are shaken out. This sand is carried by the conveyor and dumped upon an inclined belt conveyor feeding a crusher. From here it passes to a screen, over a belt conveyor, and into the sand mills. The sand mills discharge it into the Peck carrier, from which it is conveyed to overhead hoppers at the molding points.

For the latter service dump carts on a narrow gage railway were previously used. The elimination of this method has saved 100 men, or a total labor cost of $126,000 a year. The original cost of the equipment was $175,000. The cost of repairs has been very low. Power costs are likewise a minimum, 10 to 12 hp. being required for the facing sand carrier and 4 hp. for each of the core sand conveyors. The apparatus operates 16 hr. per day and the facing sand equipment handles 60 tons per hr., while the core sand conveyors handle 25 tons per hr.

To handle grain, the Bisbee Linseed Company, of Philadelphia, has installed Weller conveyor systems. Grain is received at the dock by shipload and from this point must be carried to a storage tank, and thence to the mill.

The latest equipment put in consists of a screw conveyor system under the dock, a second from there to the tank, a bucket elevator into the tank, and a third screw conveyor from the tank to the mill. Grain is fed into hoppers at 50 ft. intervals along the dock and falls into the screw conveyor, which is 355 ft. long and is divided into sections, respectively, 12 in., 16 in., and 18 in. in diameter.

A lateral screw conveyor unit 20 in. in diameter and 124 ft. long completes the delivery of the grain to the elevator at the rate of 7,000 bushels per hr., and from there it is discharged into the storage tank.

From the tank the grain passes through slide gates into a 20 in. screw conveyor, which delivers it either back to the tank elevator, when the contents of the tank are to be turned over, or to another elevator, which takes it to a screw conveyor leading to the mill. This conveyor reduces from 20 in. to 12 in. in diameter, the large section having an outlet to a second storage tank which can be filled concurrently while material is going through the 12 in. section to the bins over the machines in the mill. Two thousand bushels per hour are delivered to these bins, for 8 to 10 hr. per day. The saving over hand labor amounts to $15,000 a year, as shown in Table 7.

A direct comparison with hand methods which have been supplanted is found in the case of the Fairview Pumping station, Detroit. Steam is generated by two 280 hp. Stirling boilers and one 480 hp. Badenhausen boiler, all equipped with Detroit underfeed stokers.

A Weller conveyor system, installed in 1921, handles

TABLE 8. WELLER CONVEYOR DATA
Fairview Pumping Station

COST OF OPERATION—COAL HANDLING SYSTEM		
Depreciation—$16,900 ÷ 20 yr. of life		$845.00
[1] Average interest at 6 per cent—$\frac{21}{20} \times \frac{\$16,900 \times 0.06}{2}$		532.35
Repairs		120.00
Power—3,000 kw. hr. @ $0.02		60.00
Labor—150 hours @ $0.75		112.50
Total cost of operation, including crushing		$1,669.85
Cost per ton—$1669.85 ÷ 2,000 tons		$0.83
SAVINGS EFFECTED BY COAL HANDLING SYSTEM		
Labor cost for putting coal in bunkers and operating crane:		
1,664 hr. @ $0.50	$832.00	
416 " @ 0.75	312.00	
416 " @ 0.625	260.00	
		$1,404.00
Labor cost for firing—		
2,040 hr. @ $0.75	$1,530.00	
2,190 " @ 0.625	1,368.75	
		2,898.75
Crane expense, including power		200.00
Gross saving per year		$4,502.75
Present yearly cost of operation		1,669.85
Net saving per year		$2,832.90
Saving per ton—$2,832.90 ÷ 2,000 tons		$1.42

[1] Allowing for interest earned by depreciation reserve.

run-of-mine coal from trucks to stokers at the rate of a ton every 2 min. The trucks dump into a hopper level with the ground. A drag conveyor carries the coal to a crusher, and, after the crushing operation, it is taken by a bucket elevator up 60 ft. to a 100-ton gravity bunker.

Inside the fireroom a 1-ton carrier run by a 3-hp. motor travels above the stoker hoppers on a monorail track. The carrier is mounted on a scale to keep a check on the amount of coal handled, and is filled from the bunker and discharged into the stoker hoppers by gravity.

The fireman spends 150 hr. a year handling the 2,000 tons of coal used. In the fireroom a ton a minute can be handled.

Previous to the installation coal was dumped outside and shoveled into a 2-ton bucket which was carried by electric crane to a 200-ton bunker. Firemen shoveled from this bunker into V-type side magazines which fed the stokers. This work required 4 laborers 8 hr. a week outside, 2 men on the crane, and 4 hr. shoveling during each watch. In the fireroom a helper was required in addition to the fireman, and under heavy loads these men had trouble doing the work. Now the fireman alone handles the job with ease, at a total saving of 97 per cent of the previous labor. The complete savings are shown in Table 8.

A rotary car dumper installed in December 1923 in the plant of the By-Products Coke Corporation, at Chicago, by the Wellman-Seaver-Morgan Company, has brought about a large annual saving in costs. During the summer months coal is brought in by boat, so the dumper is used only 5 months of the year. It handles 120,000 tons per month at the rate of 7 cars per hr., although its capacity is 15 cars per hr., or, if the coal is clean dumping, 20 cars per hr.

Four men comprise the entire unloading crew—one to operate the car dumper and the electric locomotive for car shifting, one to couple and uncouple cars and clean them out, one to ride the empties down an incline, and a fourth to tend the 3 feed conveyors which take the coal from the hoppers to the main belt conveyor. The wages of the men total $660, and the power cost is $27, per month.

Before installing the dumper, coal was unloaded from flat bottom cars by means of a locomotive crane, while bottom dump cars were dumped and then cleaned out by hand. The average cost per ton was $0.11 but the car dumper has cut this to $0.017, a saving of $0.093 per ton or $11,160 per month.

Additional data on savings brought about by other installations of a type similar to those discussed above are presented in Table 9. Figures on other classes of equipment will be presented in a subsequent issue.

TABLE 9. DATA ON ECONOMIES OF VARIOUS TYPES OF MATERIAL HANDLING EQUIPMENT

Comparisons with hand methods or semi-mechanical equipment given where available. In other cases operating data only are tabulated.

Item	Type of Apparatus	Plant Where Installed and Date	Make	Handling Service for Which Used	Number Used	Loads Handled	Men Required	Men for Hand Methods	Cost of Handling by Hand	Cost of Handling by Equipment	Total Savings by Use of Equipment per Yr.	Additional Advantages Credited
1	Gravity roller conveyor Gravity chute[1]	New Departure Manufacturing Co., 1920 "	Mathews "	Tote boxes Shipping cases	3 1	150 to 200 lb.	None	4	.....	.....	$6,320.00	Aids production. Keeps work in process down.
2	Gravity chute	General Electric Bloomfield Plant 1921[2]	"	"	1	5 to 500 lb. 14,000,000 lb. per yr.	None	4 and half time of elevator	$6,435.00	$393.60[3]	6,041.40	Rapid loading of cars. Rush orders handled with speed.
3	Spiral gravity conveyor Flight conveyor	Burson Knitting Company, 1921 Installed 1923	" "	" "	1 1	210 lb. 1,000 cases per day 60,000 lb. per day	None	1	1,232.20 3,600.00	568.29 552.90	663.91 3,047.10	Saves some hauling. Rapid loading of cars.
4	Belt conveyor and gravity carrier system combined.	A Lamp Works Division Plant	"	Shipping cases and empty trays	1	.....	None None	1 and motor truck 5	5,850.00	2,253.20	3,596.80	Simplifies production layout.
5	Gravity conveying and spiral chute systems	Samoset Chocolates Company, 1920	"	Boxes and cartons of candy	3	1 to 7 lb., 4,500 to 6,000 boxes per day	None	2	3,765.00	394.48	3,370.52	Increases production 10 per cent.
6	Belt conveyor	Leathem D. Smith Stone Co., 1923	Weller	Crushed stone	3	2,000 tons daily	None	Replaced bucket elevators	.....	7,136.48[3]	.....	Doubles capacity
7	Bucket elevator and two screw conveyors in the system	Municipal Courts Building, Detroit, 1921	"	Coal	1	5,810 tons per yr.	Half time one man	Full time one man	7,284.31	4,318.89[3]	2,965.42	.....
8	Bucket elevator	Ideal Laundry Co., Inc., 1923	"	"	1	10 tons per 50 min.	.....	.....	.....	160.93[3]	.....	Increases storage capacity
9	Coal screening system	Valley Coal Co., Inc.	"	"	1	3,000 tons per yr.	.....	.....	.....	1,139.10[3]	7,095.90[4]	.....

[1] Equipment cost: Items (1) About $6300; (2) $2809; (3) Total $8,201.33; (4) $4,700; (5) $5,400; (6) $14,820; (7) $2,490.00; (8) $1,022.00; (9) $4,365.00; (10) $5,900.00

[2] Equipment not running at present due to rearrangement of plant.

[3] Present handling cost per ton: Items (2) $0.056; (6) $0.017; (7) $0.74 as against $1.25 previously; (8) $0.087; (9) $0.107; (10) $0.370.

[4] Screenings formerly sold without separation at an average price of $3.50 per ton × 3,000 tons = $10,500 per yr. Now screened and classified by Weller equipment and sold as pea coal @ $9.75 per ton, buckwheat @ $6.40 per ton, and final screenings @ $3.50 per ton = $18,735 total per yr. $18.735 — 10,500 — 1,139.10 (operating costs) = $7,095.90 annual increase in profits.

Charts as Management Tools

By ARTHUR R. BURNET

Consultant in Business Statistics

DURING the last 10 years the application of charts to business and manufacturing operations has become almost universal. Some firms have as many as 10,000 in constant use—wall charts on swing-leaf fixtures in a special chart room, loose-leaf books of charts on the executives' desks, and bulletin board charts in the operating departments of the shops. In such plants a statistical department has charge of the work and $10,000 or more a year spent for the purpose is considered a paying investment. Graphic methods have indeed become part of the necessary technique of successful manufacturing and selling.

The use of charts as mere illustrations in business and manufacturing is fast giving place to their application as real management tools. They save time and labor by presenting condensed statements of facts and relations discovered, in immediately usable form. Often they save thousands of dollars directly by pointing out misconceptions and losses. They also act as reference files or ticklers. But their most important service is that of showing *trends* and enabling the executive to forecast business developments many weeks or months ahead.

Operating reports formerly were the only basis upon which a manager could make decisions and determine policies. Now, however, by means of types of charts recently developed, he can do the same work far quicker and with a much closer approach to what actually happens. As the modern "cracking process" enables the refiner to get more gasoline from the same amount of crude oil, so the use of charts as management tools gives the executive more in the way of definite facts on which to work, than their application as mere illustrations ever supplied.

But the chart that is really an executive tool must show not merely the facts, but the facts in relation. Now, they may be in relation to themselves or to another set of facts, but the ratios and relations should be discoverable directly, right on the face of the picture. The visual impression that the charts make must be sound, whether one chart is looked at singly or in comparison with another chart. For example, the height of one curve as compared with another curve, or the steepness of one curve as compared with the steep or gradual ascent of another curve, should mean something very definite.

Too little attention has been given to graphic analysis of this kind. There seems to be a well-established but erroneous and misdirected demand on the part of some executives that the maximum amount of fluctuation should appear in each and every curve, instead of the more logical and rational requirement that smooth curves should always indicate smooth running, and irregular curves variable running or conditions. It is not necessary to accentuate maximum and minimum *points*. The *trend* is what counts. Curves that are drawn merely with respect to the space on the paper produce distorted visual impressions that are out of all proportion with the facts, and defeat the very purpose of graphic methods.

For the same reason, the effect of exceptional, temporary, and accidental occurrences, bad weather, short months, seasonal variations, and other modifying factors must be removed from the calculations.

Every successful manager must be a forecaster of

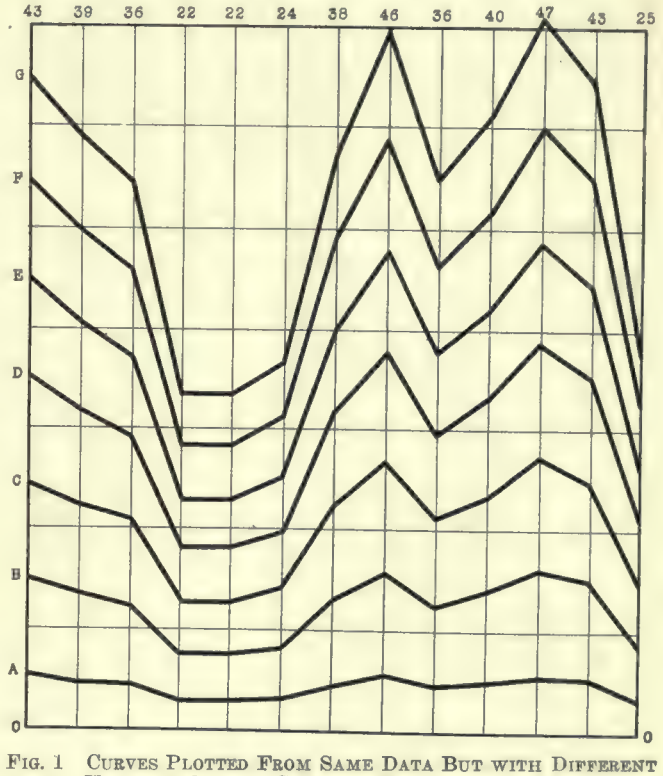


FIG. 1 CURVES PLOTTED FROM SAME DATA BUT WITH DIFFERENT VERTICAL SCALES, SHOWING DISTORTION EFFECT

his business prospects, from the very nature of his job. He is always dealing in futures, whether he makes an investment, places or accepts an order, gives or takes a loan, hires a salesman, or puts a product on the market. It is only by carefully weighing past and present facts that he can forecast correctly. Charts, properly drawn, furnish the best medium for the presentation of these facts, for they show up the really vital data in exact proportion from the standpoint of importance, and give a co-ordinated picture of the business as a whole.

The chief reason why the use of charts as management tools has been limited is this: charts have not usually been designed and drawn so as to be comparable with each other, and have, therefore, not performed for the executive the comparisons he has been

accustomed to make in his head. The charts have given him the bare facts quickly and vividly—this advantage cannot be overemphasized; but the next step was impossible. Wall charts or charts bound in a book did not lend themselves to the multitude of inter-comparisons which experience had taught him to make.

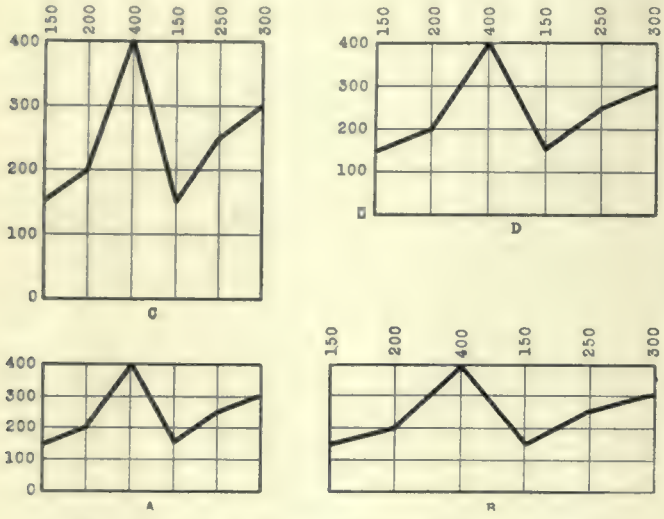


FIG. 2 EFFECT OF CHANGING SCALES INDEPENDENTLY

Each chart was an independent, detailed study, complete in itself. A new analysis or a new classification of the figures meant an entirely new chart—and delay. He did not have a unit card system in which any comparison that suited his purpose could be made instantly.

In presenting a description of the method by which charts can be made to answer all the requirements pointed out above, and therefore become real management tools, attention is called to the effect of scale selection. More important still is the making of charts to scales which permit them to be compared directly with each other. Figs. 1 and 2 bring out these features.

Effect of Scale Selection

Fig. 1 shows why it is necessary to watch scales and proportions in drawing charts which are to be compared with each other. All curves in this chart—A, B, C, D, etc.—are plotted from the same data, appearing across the top of the drawing, but to different vertical scales. Note how the increase of scale distorts the curves in the upper part of the diagram.[1]

In Fig. 2, A is the original plotting. B has the same vertical scale as A but a wider horizontal scale, and C vice versa. D is a reproduction of A with both scales enlarged in the same proportion. Note that while D resembles A, both B and C are badly distorted.

As the plant executive bases his decisions not on absolute amounts, but on rates and relationships, it is very evident why a system of *comparable* charts, plotted with scales that bear a real relationship to each other, are by far the most valuable from every standpoint. Let us see how such charts have been actually made and used with the above objectives in mind.

A certain concern producing 50 distinct products, and operating more than 20 branch offices, uses trend charts to follow sales. Over 1000 reports on total sales of each kind of product thus come into the main office each month. Analysis of these reports is a stupendous job by ordinary inspection.

But reduced to trend charts, the process is simple. The total sales and the sales for each branch are plotted on separate charts. Then these 20 or more charts are placed, one directly above the other, and clipped to a piece of stiff cardboard. The data of all branches for any one month, therefore, appear in the same vertical column, and the trend of each line can be compared with that of the total or of any other. This work is done by a clerk, who calls the manager's attention to the results, especially if sales are falling off in any place. Similar charts are made for each salesman and placed for comparison as shown in Fig. 3.

Another concern produces about a dozen different products, some of which are manufactured in two plants widely separated. The sales are recorded on a printed operating statement showing sales in weight and value, by the two plants separately and combined,

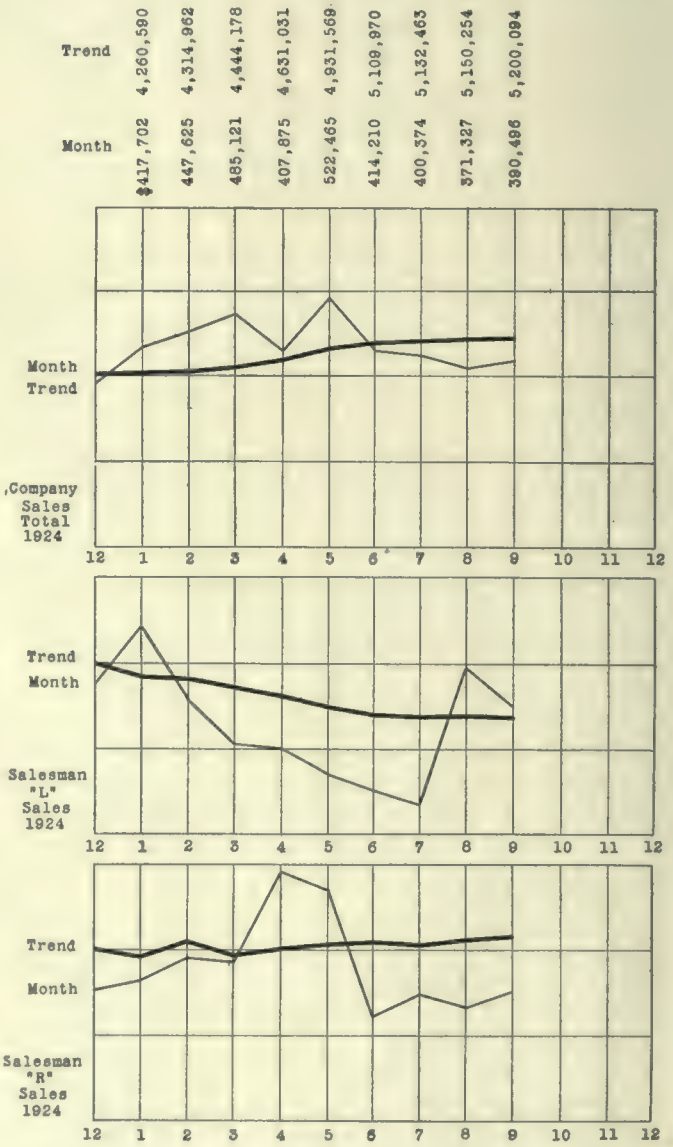


FIG. 3 SALES CHARTS IN POSITION FOR COMPARING

[1] A mechanical device is on the market, whereby the correct position of curves can be readily located on the field.

and direct and consignment sales. All this is given for about 40 states of the Union, and is shown in totals and in detail. The individual monthly sheets contain a mass of figures, and the record for a year or two makes a bulky pile which the executives hesitate to look through, although, in this day of a buyer's market, the pile contains information vital to the business.

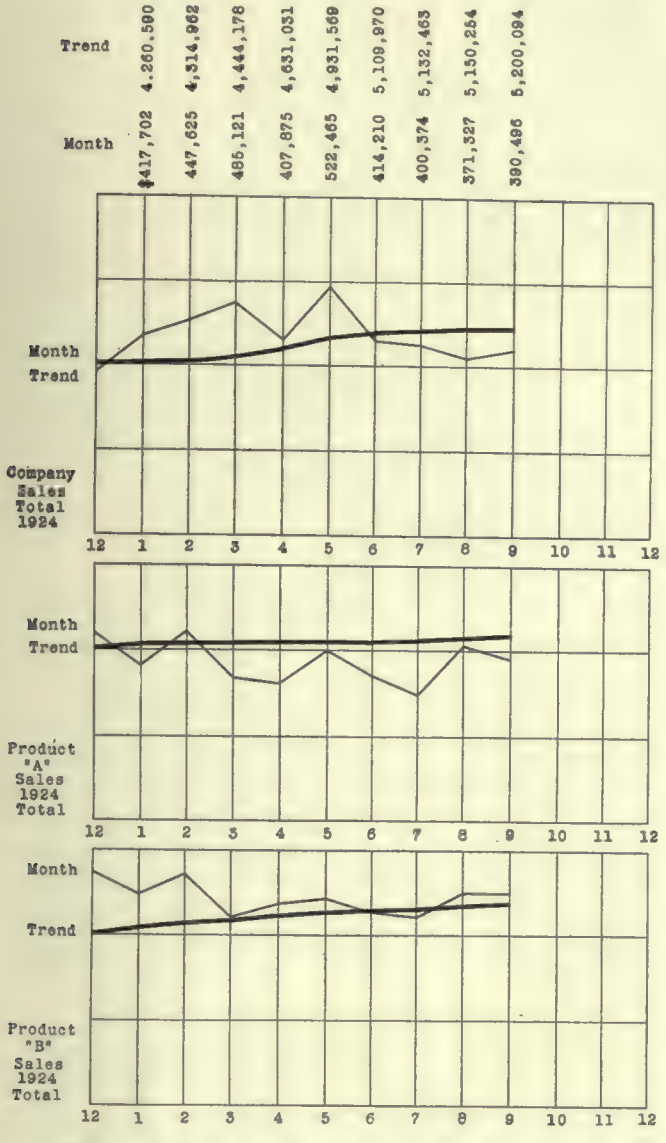


FIG. 4 SALES COMPARISON BY TOTALS AND PRODUCT

The transferring of this mass of crude information to comparable trend charts was like the "cracking process" referred to above. One significant comparison was made by placing the charts one above the other and photostating them in that position, then the arrangement was broken down, other comparisons set up, and the charts photostated again. The managers now have regularly presented to them comparisons of which samples are illustrated in Figs. 4 and 5.

Two sets of comparable trend charts similar to Figs. 3 and 4 were prepared for the first time in a certain company which has sales branches in various parts of the country, and were shown to the president. There were two charts for each branch, one for sales and one for expense. The salesmen for all the branches were charted in the same way—two charts for each one. The business analyst knew that the expense rates were high, and were still going up, but he waited. After examining the charts a few moments, the president threw up his hands, and with a pretty vigorous oath exclaimed: "This hasn't been going on for a few months. It's been going on for 18 months, hasn't it?"

Now that chief executive had been regularly receiving operating statements showing branch sales and expense, month after month, and yet it was not until he saw the comparison between the two sets of trend charts that he was able fully to realize the import of the situation. Each month's report had come along separately. He undoubtedly had noticed from time to time that the rates were high in certain spots, but it took the charts to piece the picture together and to show him the whole situation. By the help of the charts he was able to make intercomparisons—branch with branch, branch with total company, salesman with branch, salesman with salesman, etc.—and take steps to better his sales results.

Comparing Widely Separated Plants

Two plants located in different parts of the country produced almost identically the same products. They operated under widely varying conditions, but the charts recording the operations of the two were put on a comparable basis, and it was possible to make direct comparison of production rates, manufacturing costs, labor charges, etc.

A large manufacturing concern whose costs for raw materials run into millions of dollars, uses charts similar to Fig. 6, which bring into the same focus the three vital elements of receipts, withdrawals, and stock. There never was any question as to the accuracy and completeness of this company's numerical record of raw materials control, but the managers found that a visualization, not merely of the facts, but of the relationship of those facts, was a great help in keeping inventories low, and yet adequate enough to supply an elaborate manufacturing process. The subject of Fig. 6 is cement production, shipments and stock, but it is easy to see how a chart of this kind is applied to raw materials control. The broken line may represent receipts, the lower solid line withdrawals from stock, and the shaded zone the amount of raw materials on hand. At a glance, the eye can see how many months' supply is on hand at any given month. No calculation is necessary, the ratio is self-evident.

Charts in the Motion Picture Industry

Charts as management tools have even been applied to the motion picture business, characterized by some people as a "game" rather than a business. Motion picture accounting is built around the individual picture. The commodity unit is the picture, and the unit of time is a week. Among the records kept are separate production costs for the original negative, film rentals, and "unplayed contracts," that is, the rental

value of the films contracted for, but not yet shown at the motion picture theaters, and finally, exploitation costs, or as we would say, cost of advertising.

Watching these factors for 50 or 100 pictures weekly is a rather complicated piece of work. Some pictures cost as low as $50,000, others many times that amount. Before a picture is released, negative costs may be greatly added to by changes and alterations, and additional prints that are made may or may not increase the distribution, but they most certainly add to the cost. The time of release in reference to the theatrical year has a marked effect, as has also the releasing of pictures singly or in groups. A large volume of contracts for films to be shown later does not necessarily mean an equivalent in film rentals, because of cancellations. A district supervisor may go out for the purpose of getting in film rentals or to secure "play dates," as he calls it, and come back with a load of cancellations.

Forecasting the Success of Photoplays

All this is cited to show the complicated nature of the motion picture business. It is theatrical. It depends upon the whims of the public taste. And yet to this "game" management charts have been applied with the following striking results: (1) Characteristic shapes appeared in the curves, so that it was possible to determine in a reasonable time after the release date whether the picture was likely to be a "good" picture, that is, whether 75 per cent or more of its cost would be returned within the first year; (2) probable returns from individual pictures could be determined within reasonable limits; (3) it could be estimated what percentage of unplayed business was likely to result in cancellations, and what in play dates and film rentals; (4) running estimates 13 weeks in advance, showing branch sales (rentals) and branch expense by individual branches and the total for the company, were made within a probable error of from 3 to 5 per cent.

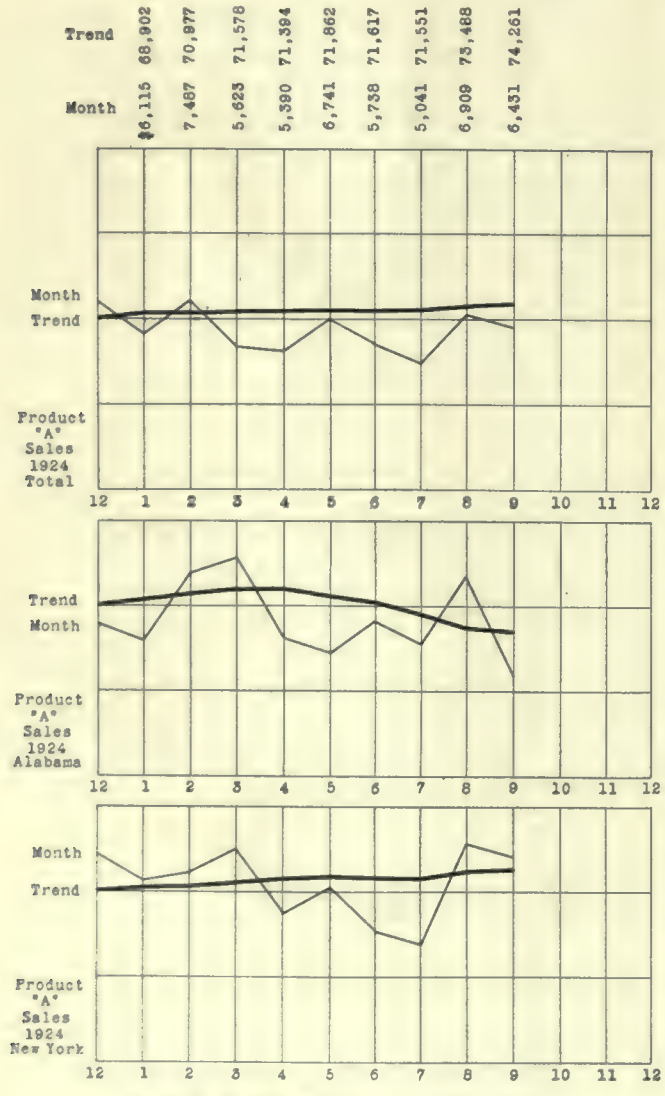


FIG. 5 SALES COMPARISON BY STATES

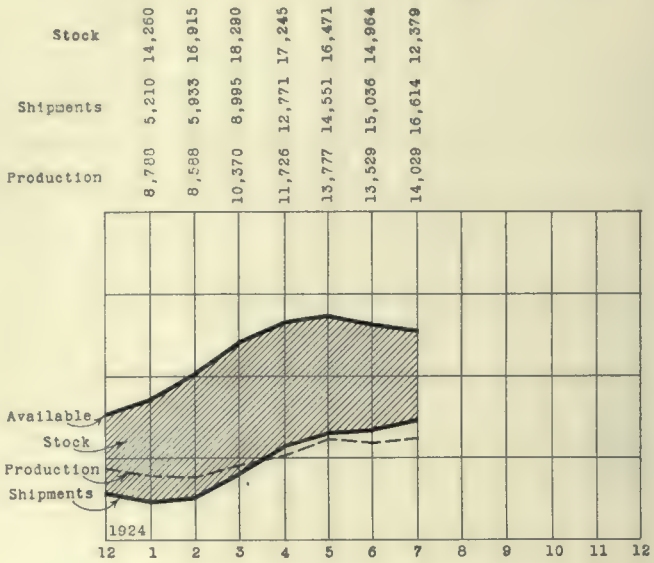


FIG. 6 COMPARISON OF STOCK AND SHIPMENTS

Use of Charts as Management Tools

These examples suggest some of the possibilities of charts as management tools. They are cited here to emphasize the distinction between the use of charts as illustrations and as tools. The primary purpose of charts is, of course, to elucidate, to picturize, to give a quick, clear-cut, condensed picture of the figures. But when drawn in comparable form, charts have a second purpose far more important to the executive than the first. It is not merely to make the grasping of the figures easier, but to get at the facts behind the figures—the ratios, the relationships, trends, and movements. These are the things that the executive works out mentally after the figures are given and understood. To use charts only as illustrations is like employing an adding machine for the sake of the clear, legible figures it prints. The eye could then more quickly and easily run along the column, but the figures would still have to be added. On the other hand, using charts as management tools is like pressing the total key, and getting the result at once.

Standards in Clothing Manufacture

Making Garments That Fit Without Alterations

By GEORGE E. F. SAUM

Industrial Engineer

THE major branches of the ready-made clothing industry, which depend upon human measurement standards, turn out a production running up into the billions in annual value. Table 1 gives a list of the important products in this field, with the 1921 U. S. Bureau of Census reports of the value of their annual output.

The value of the annual production of the two items, men's and women's clothing, in the table totals up to $2,371,528,761. Approximating the outer and lining fabrics included in the summary to be 45 per cent of this amount, we get $1,067,187,942 as the portion in which the efficiency of use is of prime importance.

TABLE 1. VALUE OF ANNUAL OUTPUT OF MAJOR INDUSTRIES REQUIRING BASIC HUMAN MEASUREMENT STANDARDS

U. S. Bureau of Census (1921 Reports)

Industry	Value of Production	Total
Men's clothing [1]	$1,162,985,633	
Men's shirts	205,327,133	
Men's collars and cuffs	47,564,949	
		$1,415,877,715
Women's clothing [1]	1,208,543,128	
Corsets	75,541,959	
		1,284,085,087
Knit goods:		
Underwear	203,530,283	
Sweaters, jerseys, cardigan jackets, etc.	67,739,247	
Hosiery	308,662,377	
		579,931,907
Paper patterns [2]		15,680,946
Boots and shoes		1,271,958,870
Grand Total		$4,567,534,525

[1] Not including custom-made clothing.
[2] Adjusted figures from 1921 Census.

Size standardization offers the possibility of unusually large savings in the manufacture of clothing. It is essentially a problem concerning designers and manufacturers.

No attempt is made in this discussion to touch upon style factors, which in themselves, under standardization, open the way to great economies.[1] In standardizing style factors the sales problem is the first consideration. Size standardization, scientifically carried out, will not meet with sales resistance, but, on the contrary, will aid in breaking it down. The reason lies in better-looking, neater-fitting clothes, and the elimination of alterations.

Many persons not now able to get a good fit in ready-made clothing can be correctly fitted if the relative proportions of garments are adjusted to the various types of the human form. That this is not a condition existing generally at present is shown by Table 2. The table, compiled in the spring of 1924 from data supplied by paper pattern manufacturers, shows waist and hip measurements relative to bust measurements, in use by 8 companies. There is neither agreement nor uniform variation in these sizes. This, as a general practice, is the reason why alteration bills are high and add to the selling price of garments. There is no reason why such a condition should prevail, as the trouble is readily preventable.

Misfits in clothing arise from causes, some of which can be corrected, while others, by their nature, cannot be. A rough division of misfits into the two groups is as follows:

1. Possible of alteration because sufficient fulness has been allowed.
2. Impossible of alteration because material has been skimped in manufacture.
3. Avoidable, and resulting from lack of modal standards in manufacture, limit of forms and sizes in stocks of retailers, and inefficient form and size selling on the part of salesmen.
4. Unavoidable, and resulting because the purchaser is out of the modal range of standards, or, in retail selling, because a customer insists on taking a model or material for which the right form and size are not in stock, or demands extremes in forms and designs.

Men's clothing manufacturers have accomplished much in the line of reducing alterations by their progress toward perfecting the classes of forms and the variables of measurement incident to each. As a result, there is a growing preference among men for ready-made clothing, especially that from the manufacturers of higher grades. The general classes of forms recognized in the men's outer clothing industry are:

Men's		Young Men's
Regular	Short stout	Regular
Short	Long stout	Short
Long	Long Medium Stout	Long
Stout		Prep.

Manufacturers of corsets and the better grades of women's cloaks and suits have also adopted class distinctions similar to the above.

[1] See Management and Administration, September 1924, p. 289.

TABLE 2. RELATIVE BUST, WAIST, AND HIP MEASUREMENTS USED BY DIFFERENT PATTERN-MAKING COMPANIES, SPRING OF 1924

Company	Bust									
	32	34	36	38	40	42	44	46	48	50
	Waist									
A	24-25	26-27	28-29	30-31	32-33	34-35	36-37	38-39	40-41	42-43
B	..	26	28	30	32	34	36	38	40	42
C	24	26	28	30	32	34	36	38	40	42
D	26	28	30	32	34	36	38	40	42	..
E	24	26	28	30	32	..	..	..	..	..
F	24	26	28	30	32	34	36	38	40	..
G	..	26	28	30	32	34	36	38	40	42
H	23	24	26	28	29	31	33	35	37	39
	Hips									
A	35	37	39	41	43½	46	48½	51	53½	56
B	..	37	39½	42	44½	47	49½	52	54½	57
C	35	37	39	41	43½	46	48½	51	53½	56
D	35	36	38	40½	42½	45	47½	49½	52	..
E	35	37	39	41	43	..	..	..	..	..
F	34	36	39	41	43½	46	48½	51	53	..
G	..	37	39	41	43½	46	48½	51	53½	56
H	35	36	38	40	41	43	45	47	50	51

In the United States the cost of alterations reaches a tremendous sum, even on the basis of a very conservative estimate. Using the 1921 figures again, but adjusting them to include only those garments in which alterations figure, we have:

Value of annual production of men's and women's clothing (adjusted)	$1,682,495,253
Retail mark-up (Approximated at 50 per cent)	841,247,627
Total	$2,523,742,880
Annual alteration costs (Approximated at 3 per cent)	$75,712,286

It is a well-known fact in the science of mathematics that there is a modal, or most representative, frequency in all kinds and classes of data. This law applies in the realm of nature as well as to products of human effort. Measurements of the human form group themselves according to type. For each fundamental size, say that of the chest, there is a marked frequency of agreement between the corresponding waist and hip measurements of people of the same general type.

Hence, if a large number of men and women are accurately measured and the resulting data are analyzed according to the laws of mathematics, taking, for example, normal chest measurements as the basis, it will be found that waist and hip measurements fall into groups. These groups correspond to types of people rather than varying uniformly with respect to each other. This principle, the sticking to type rather than to a uniform variation, is called the law of regression, and its operation is very marked in human measurements.

A study of this subject, undertaken, at the time, for its physiological aspects rather than with an idea of industrial application, was made at Pratt Institute a few years ago. As time does not change the usefulness of such data, and as the methods and results are identical, on a small scale, with those that the clothing industry will follow when it attacks the problem of scientific size standardization comprehensively, a portion of the data is reproduced here.

Table 3 shows the summary, by groups, of chest and waist measurements of 2139 female students, taken from the physical training department records of Pratt Institute. Fig. 1 shows the corresponding regression line of actual variation and the line which would represent uniform variation, if the measurements varied according to a uniform law. The small circles are the actual points from which the regression line was determined.

Calculation sheets, and tables of waist relative to hip measurements, and chest relative to hip measurements, together with their regression curves, were made up, but have been omitted here to conserve space. The waist relative to hip curve (not reproduced here) shows a greater spread between regression and uniform variation lines, while the chest relative to hip curve plottings of these two lines are markedly divergent. Fig. 2 shows the spread between relative measurements for the total of 2139 observations.

The investigation showed a high degree of correlation of data. A higher degree would have been evident if the data were taken according to a standard practice from a much larger group, based on normal and not expanded chest measurements, based on the present tendency to avoid tight corset-lacing, classified according to the human form, and considered separately instead of as a unit. Even better results can be obtained by measuring the male rather than the female form,

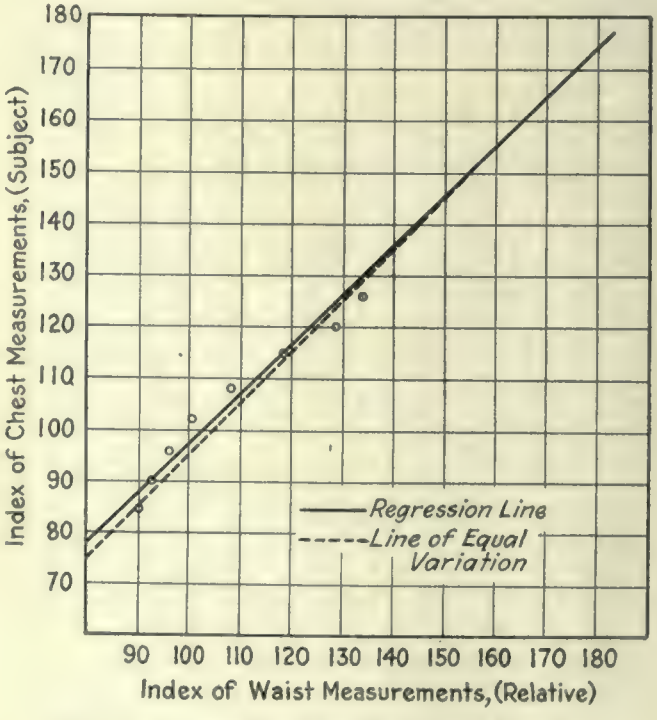


FIG. 1 REGRESSION AND EQUAL VARIATION LINES FOR RELATIVE MEASUREMENTS

and the sales value is all the more important in men's clothing because of great inclination on the part of men to buy ready-made clothes if they fit well. All measurements should be made, of course, in the nude, to avoid errors. In designing and manufacturing clothing such elements as fulness, lines of cut, style, and other features of art and individuality can be added at the least cost consistent with ready selling of the product.

Trade associations are already becoming active in the effort to determine measurements and standardize sizes. In the 1924 annual report of the Associated Knit Underwear Manufacturers of America, the secretary, Roy A. Cheney, states that a research fellowship in the subject had been founded by the association, the appointee, to work with the Bureau of Standards.

Extensive laboratory work is planned. Investigations will cover men's, women's, children's, and infants' garments, union and two-piece suits, in every type of knitted fabric. When complete and reliable results are obtained, the standards developed will be submitted to manufacturers in the industry, for general voluntary adoption. No government coercion is to be employed.

After the standards have been accepted by the members of the association a measurement stamp or label will be adopted to read something like this:

This garment made according to measurements approved by the U. S. Bureau of Standards.

Only those who agree to the standards and put them into actual effect in manufacturing will be licensed to use this label. Manufacturers who violate their agreements will have their licenses revoked.

The adoption of these standards based on scientific measurements will not remove from the market low-grade goods produced by non-members of the association. But a standard value will be set up which will strengthen public confidence in the industry and will take sub-standard goods out of competition with standard.

Likewise, the National Knitted Outerwear Association, in June 1924, decided to establish a fellowship in the textile section of the Bureau of Standards for a similar scientific investigation of measurements and determination of standards.

This association also contemplates a standard license label. The same problem is faced as in the case of the underwear producers who have had to meet strong competition from makers of sub-standard goods. As an inch or two shortage in the length of a sweater means a large saving in wool yarn under conditions of mass production, skimping of materials by these makers of inferior grades constitutes a serious element of unfairness. The object of the standard label, which will be similar to the underwear maker's label, is to protect the public.

If concerted action along these lines is undertaken by all clothing trade associations and manufacturers, every branch of the industry will benefit by the large resultant savings and probable increase of trade. Management methods, scientific and engineering ability, accurate measuring apparatus, and rapid calculating and tabulating equipment, are all available for the work.

By the establishing of an apparel anthropometric association organized for comprehensive research, with work conducted along the lines already started by the knit garment manufacturers, and with life insurance and medical associations, Y.M.C.A.'s, Y.W.C.A.'s, representative schools, colleges, universities, the army and navy, and the personnel departments of all manufacturing enterprises to draw on for assistance in gathering measurement data, the work of standardization can be quickly and conveniently done.

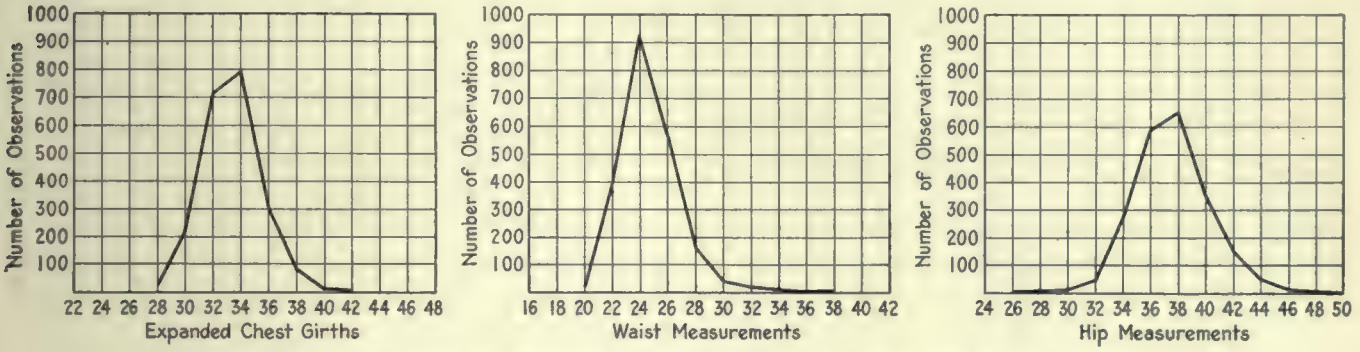


FIG. 2 SPREAD BETWEEN RELATIVE MEASUREMENTS FOR TOTAL OF 2139 OBSERVATIONS

TABLE 3. RATIO OF VARIATION BETWEEN CHEST AND WAIST MEASUREMENTS
2139 Female Students, Physical Training Dept., Pratt Institute [1]

No. of Students	Expanded Chest In.	Median [2]	Waist in Inches										No. of Students	Aver. Waist of Group	Median [1]
			20	22	24	26	28	30	32	34	36	38			
20	28	83.9	3	13	3	1	..	..	..	..	..	..	20	22.2	90.0
215	30	89.9	13	130	65	5	2	..	..	..	..	..	215	22.9	92.8
712	32	95.9	2	205	418	85	2	..	..	..	..	..	712	23.7	96.0
790	34	101.9	..	44	405	305	35	1	..	..	..	..	790	24.8	100.5
300	36	107.9	..	..	40	152	88	16	1	2	1	..	300	26.6	107.8
88	38	113.9	..	..	2	16	31	22	11	4	..	2	88	29.0	117.5
12	40	119.9	..	..	..	..	1	2	6	3	..	..	12	31.8	128.8
2	42	125.9	..	..	..	..	..	..	1	1	..	..	2	33.0	133.7
Totals 2139	....	....	18	392	933	564	159	41	19	10	1	2	2139	....	....
Aver.	33.36												Average	24.68	

[1] Columns 1, 2, and 3 are subject data, the rest being relative data (See Fig. 1).
[2] The median is the average of the group divided by the average of all at the foot of the adjacent column.

Identification of Industrial Piping Systems

THE Sub-Committee on Identification of Piping Systems by Markings Other Than by Color[1] submits the following report, the conclusions for which were arrived at from field investigations and personal interviews with operators and designers of power and industrial plants, and also from articles appearing in the technical press. An attempt was also made to discover the methods of pipe line identification employed in the foreign field and it was found that practically no attention has been given to the question of pipe markings and that, where paint is employed, its application is intended as a protection for the pipe covering material rather than as a means of determining the fluid in the lines.

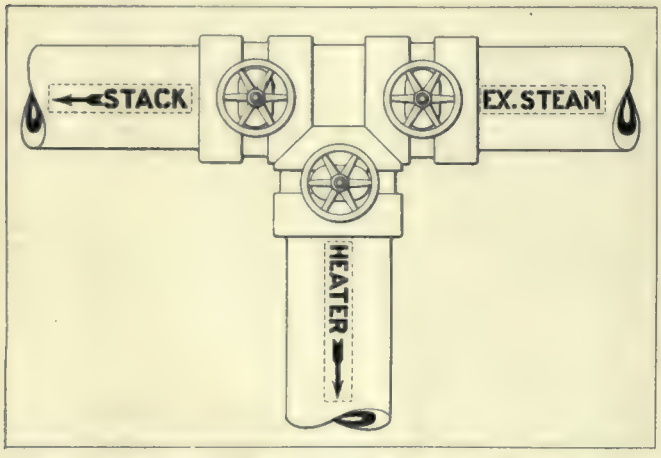


FIG. 1 STENCILLED MARKINGS TO IDENTIFY PIPING

It was first thought that the work of the Committee should supplement the report of the Sub-Committee on Identification by Color,[2] but as the subject matter of this report will indicate, it apparently becomes a separate phase of the subject. We have, however, made certain suggestions pertaining to color with reference to the proposed markings.

The first efforts of our committee centered upon a combination of symbols or hieroglyphics along with a legend naming the nature of the containing fluid, the legend with its accompanying symbol appearing prominently at the points of supply to the piping system and at points of distribution therefrom, any further marking at intermediate points along the pipe line to consist of the symbol only.

We have since discarded the symbol idea entirely and now consider it impracticable because of the great mass of detail involved, the difficulty an operating force would encounter in recalling to mind the different shapes and forms, and the probable necessity for the issuing of code books by operating companies.

The Sub-Committee on Markings Other Than Color recommends for consideration the following:

That the form of identification marking shall consist principally of a lettered legend, abbreviated or otherwise, naming the material carried in the pipe line. Where a knowledge of the direction of fluid flow may be of service, it is suggested that arrows be painted on the pipe. (See Fig. 1.)

Attention has been given to the question of visibility with reference to pipe markings, and this committee recommends that where pipe lines are located some distance above the normal line of the operator's vision, the lettering be placed below the horizontal center line of the pipe. It is desirable, where the view is unobstructed, that the lettering employed be stencilled on the two lower quarters of the pipe covering.

In certain types of plants it may be desirable to label the pipes at junction points or points of distribution only, as suggested in Fig. 1. In certain existing power plants the markings are repeated at intervals all along the pipe line. In any case, the operating man should decide the location and number of signs required.

Regarding the type and size of letters and numbers, we recommend the use of stencils of standard sizes, easily obtained from any stencil manufacturer, ranging in height from ½ in. to 3½ in. as shown in Table 1. For pipes smaller than ¾ in. in diameter, requiring identifying marks, we suggest the use of a metal tag with the lettering etched and filled in with enamel.

With regard to visibility the eye as a matter of habit is most accustomed to the reading of black letters on lighter backgrounds and our investigations in plants of different kinds have disclosed the fact that a large number of signs and other designations are made with black letters on a background of aluminum paint. We have learned that vehicles have been developed which, with aluminum powder, make a paint which will stand up under temperatures from 700 to 900 deg. F., without loss of color or adherence. We therefore suggest that the black letters be either painted or stencilled on a rectangular background of aluminum about as indicated by the dotted lines in Fig. 1; or the "Median Gray" in the Color Committee's report can be used.

We believe that the system of marking here suggested is the most practicable form, and recommend its adoption. Comment and criticism will be appreciated.

TABLE 1. SIZES OF STENCIL LETTERS FOR VARIOUS PIPE DIAMETERS

Outside Diameter of Pipe or Covering Inches	Size of Stencil Letter Inches	Outside Diameter of Pipe or Covering Inches	Size of Stencil Letter Inches
¾	½	5	1½
1	½	6	1¾
1¼	½	7	2
1½	¾	8	2½
2	¾	9	2½
2½	⅞	10	3
3	⅞	11	3
3½	1¼	12	3½
4	1¼	13 and over	3½
4½	1½		

[1] Tentative report of a sub-committee of the Sectional Committee organized under the rules of the American Engineering Standards Committee by the joint sponsors: The American Society of Mechanical Engineers and the National Safety Council. Personnel of the sub-committee making this report: Chairman W. S. Morrison, Willis Lawrence, J. J. Howe, R. C. Taggert, T. M. Gevrenz.

[2] See MANAGEMENT AND ADMINISTRATION, March 1924, p. 297, for this tentative report.

Waste Elimination Through Executive Control

By W. PENN LUKENS

Assistant Manager, Industrial Engineering Department, Arthur Andersen and Company

IN the year 1921 an able jury returned a forceful and voluminous indictment against business management in the United States. The defendant was accused of being responsible for 50 per cent of the waste in present-day industrial processes and this accusation was supported by actual facts, figures, and examples to such a degree that the charge cannot be ignored or lightly dismissed. The jury was Mr. Hoover's Committee on the Elimination of Waste in Industry, and its report is being quoted and discussed in an ever-widening circle of interest. It is still too early to look for the corrective results from this report, but management in many quarters is actively questioning the most effective means of securing improvement in the conditions pointed out. Since the report was developed largely from an engineering viewpoint, it is to the industrial engineer that management turns for advice.

It is unfortunate that the work of the industrial engineer is popularly believed to be mainly concerned with the direct control of production—chiefly the making of more things in less time or at lesser cost—for important as this work is, it does not, as usually conceived, go to the heart of the problem of industrial waste. Indeed it does not touch the broader wastes in industry at all.

It has been the writer's experience that the greatest industrial waste arises from the lack of co-ordination of the effort of the different functions which, as a whole, make up the work of any going business organization. Therefore any plan which seeks to eliminate waste or to increase earnings through the improvement of any one department alone, such as sales, accounting, or plant, contains in itself the seed of partial failure at least. To be successful a program of industrial improvement must be based not upon the desire for theoretical perfection for its own sake—as is too often the case with production revisions initiated by and confined to a purely engineering examination of the business—but upon increasing the effectiveness, as measured in earnings, of the business as a whole.

This may sound mercenary, but, as industrial society is organized, the management of any plant is judged by earnings alone. If stockholders are wise it is judged over long, rather than over short periods, it is true, but the balance sheet is the acid test of management.

Any sane, businesslike program of waste elimination must then be based upon the prospect of making a substantial contribution to the earnings of the company as a whole, and the period in which this result is to be accomplished must be of reasonable length. This does not mean that every step taken must show provable economies or that results are to be expected overnight. In a way it means just the opposite — that long-run results can be secured only by a consistent program and some parts of this (usually the preliminary parts) cannot, by their very nature, show direct results. It means also that the entire program must be based upon an analysis of the business as a whole and that each move in securing results must be studied in its relation to every portion of the organization.

"The balance sheet is the acid test of management. Any successful program of waste elimination must then have for its goal increased earnings for the business as a whole and over a reasonable period. This does not mean that every step must show provable economies or that results are to be expected overnight. It does mean a carefully arranged and consistent program based upon an analysis of the business as a whole and with every important move studied in its relation to every part of the organization."

Perhaps the industrial engineer is to blame for the prevalent failure to recognize these fundamental rules. The general public has become familiar with him in his more detailed and limited rôles. It knows him as a time-study or motion-study man, or as adviser on plant equipment and plant layout, or as the installer of cost and production "systems". In short, the engineer has too often been forced to compromise, delivering partial benefits because he feels that the broader program would not be authorized. To quote the words of a prominent member of the profession[1]:

> . . . a practicing industrial engineer is regarded as a doctor and is called in only in an emergency, and then to cure a specific illness. [He] . . . will rarely be permitted to operate—he will be forced to content himself with a purely local application and will leave knowing that the trouble is bound to recur unless its actual cause is removed.

But if the engineer had a free choice, the operation would be performed—not so drastic an operation as to prove even temporarily crippling, but one which might prove painful to the executive pride.

There is a second point for which the engineer must accept some blame, and that is the failure to recognize the fact that the examination of any business will be inadequate unless it is made both by means of accounting and engineering analysis. While it is true that an examination of the accounts of a business—even if this includes a careful analysis of past opera-

[1] William R. Basset, "The Organization of Modern Business."

tions—will tell but little with respect to the steps to be taken to eliminate wastes, it is equally true that an unsupported engineering analysis is very apt to lose sight of the practical goal of this search for waste, namely, increased and stabilized earnings.

Yet, assuming that the engineer has been authorized to carry out a complete program for the elimination of waste through the establishment of executive control, and that he is aided in his examination by competent accountants, there still remains one essential to successful carrying out of the work. Briefly, all of the steps necessary to this program must be absorbed by the management and executives. Any plan, no matter how comprehensive and practical it is in other respects, which does not recognize the fact that work of this kind is essentially educative, and that it can be permanent only to the extent to which major and minor executives understand and accept its fundamentals, is certain of ultimate failure. We cannot hope to control the larger wastes of industry unless we understand the fundamental causes which bring about the inevitable results of lessened earnings.

Causes of Industrial Waste

When waste is charged the natural impulse is to blame some one person and to direct the corrective campaign against that person rather than against the underlying causes for the condition. It is this very human tendency which has led us to say that management is responsible for such and such a percentage of waste, when as a matter of fact we really mean that some types of waste are the result of underdeveloped executive control, and that certain other wastes result from failure of the management to educate the workers in correct methods and principles. While in some individual cases loose personnel control may be to blame for management wastes, yet in a broad way the real cause lies not in the individual but in the lack of a plan for securing tighter control.

It would be very astonishing if we did not have large wastes in industry today. Industry on its present scale would have been impossible previous to 1870, both from the standpoint of the mechanism of production and the mechanism of distribution. Since that date the size of the industrial unit has expanded very rapidly (forced both by the mechanism of production and the mechanism of distribution), and it is only in recent years that we have come to realize that the size of the industrial unit has grown faster than we have developed the methods of economical executive control for these vast businesses.

Wastes of Poor Control Concealed

Even in recent years rapidly expanding domestic markets, vast natural resources, and mechanical superiority have temporarily covered up the true significance of the wastes of poor control, and it is only in these post-war days, under the alternate battering of business by prosperity and depression, that industrial waste appears as an outstanding defect. Like the poor, it has been always with us, but in the past three years it has become noticeably painful and correspondingly important.

The report on the elimination of waste in industry may be likened to the diagnosis of a skilled surgeon who analyzes the extent of a particular injury. Certainly it is a forceful commentary on conditions, and well worth the quoting and re-quoting accorded it by engineering and economic publications. Its blunt truths strike a responsive chord from labor economists and from purveyors of business statistics, but most of all they evoke mingled feelings of pride and despair from the ranks of industrial engineers. Pride—because the report so forcefully speaks the lesson the engineer has been trying to drive home since the days of Taylor. Despair—because even so militant a message so frequently falls harmless against the barrier of the executive who entrenches behind the thought—"But my business is *different!*"

Requirements for Elimination of Waste

The question naturally arises as to how the executive may develop a control which will, with more or less efficiency, minimize waste.

To demonstrate the points and bases of control the following quotation is made from an exhibit on "Waste in Industry," prepared under the writer's direction and presented before the National Construction Conference held in Chicago in April 1922:

> The factors of management which must be brought under control to eliminate waste:
>
> 1. *Organization Plan.* Every person must do the work for which he is best qualified and must know his responsibilities. Authority must equal responsibility and be clearly defined.
> 2. *Sales and Sales Distribution.* Control is gained through the use of analysis charts and the use of quotas. Sales must work in harmony with finance and production.
> 3. *Labor.* Waste is caused by idleness, by misdirected or unnecessary labor, by high labor turnover, and by lack of a complete record control.
> 4. *Material.* Waste is caused by poor material arrangement, by lack of material records, use of improper material, faulty methods of handling, and faulty purchasing control.
> 5. *Equipment.* Waste is caused by failure to use correct equipment or by faulty arrangement of equipment.
> 6. *Production.* Output can be increased by proper control over labor, material, and equipment. Uniformity of production and good record control over production decrease waste. Correct design is one element of production control and a knowledge of costs is the link between production and finance.

Evidently one further phase of executive control is omitted—that of financial control. It is at this point that the engineer and the accountant must work together, and failure to give full weight and scope to this co-operation is, as has been pointed out, the usual weak spot in an analysis of this kind. Then let the seventh item be added:

> 7. *Finance.* Waste arises from the failure to correlate sales and production with financial conditions. Lack of

complete financial (accounting) records and the failure to use accounting records to reflect operating and sales results lead to incomplete executive control.

Each of the above paragraphs might be expanded into book form—in fact many books are available on most of these subjects. Here, however, we are concerned only with the practical application of engineering methods to bring about a degree of executive control otherwise impossible.

Organization as a Factor in Eliminating Waste

Organization is the first and most vital feature. How many businesses are able to define their organization plan? Comparatively few. It is surprising to find a company in which any sort of organization chart has been drawn, and it is remarkable that in many plants it is extremely difficult to chart the organization. One case is recalled in which the question was asked, "What are Mr. So-and-so's duties?" and the answer was given, "Oh, he is the general manager's nephew." Another example was that of the company which had a "Sales Manager" and also a "Manager of Sales," and neither had any authority over the other, but both claimed full authority over the rest of the sales division. Perhaps the simplest way of showing organization defects is the mere listing of weaknesses which have repeatedly come to the writer's attention—naturally not a full list of possible weaknesses, but a compilation of some few of those which are outstanding and frequently found.

1. One man controls the entire business.
2. No provision is made for an understudy who can carry on the business in the event of death or retirement of the main executive.
3. The control is poorly functionalized.
4. The control is poorly centralized.
5. The organization is physically decentralized.
6. The organization plan is indefinite.
7. The esprit de corps is poor.

Remedy for Organization Defects

The remedy for organization defects is of course dependent upon local conditions, but in general the following procedures may be adopted:

1. Analyze the organization as it exists and chart it in some easily understandable manner.
2. Go over this chart, keeping in mind local conditions and personnel as well as the things which have proved correct in similar companies or in business in general.
3. On the basis of this study, chart a proposed organization plan in which the personnel will be correctly placed, in which authorities will be clearly defined, in which control functions will be the governing influence rather than men or jobs, and which may be "grown to" gradually by the present organization.
4. Take this plan up with the management, convincing them of the correctness of clearly defined functions, responsibilities, and authorities. Supplement the chart with written definitions of duties where there is any doubt.
5. Use the agreed-upon organization plan as the basis upon which all other elements of management control will be developed.

The importance of a clear and correct organization plan cannot be overemphasized. It is the fundamental element of management control. What good does it do, for instance, for the general manager to call a meeting of department heads and state, "We are going to install a cost system," when no one knows who is to do the work or to be responsible for its success? Suppose he goes a step further and adds, "Mr. Smith will be responsible for the work". Yet, with a poorly defined organization Mr. Smith, as accountant, will probably get into trouble with Mr. Jones, the shop superintendent, and possibly with Mr. Brown, the production manager, or may find that the stockkeeper will take instructions only from the general manager. Under these organization handicaps the cost system's installation is probably doomed to an early death.

Proper Financial Control as a Factor in Eliminating Waste

The subject of organization is broad and comprises many details. Undoubtedly many of the details of both good and bad organizations will occur to anyone who thinks back over his own experiences. Fully as vital, however, and often more immediate and obvious in its effect upon the life of the business, is the subject of financial control.

Experience has shown that the following weaknesses in financial control of business are common, recurring time and again:

1. The company obtains no costs.
2. Costs are incorrect.
3. Costs are not used as a basis to secure an operating control.
4. The accounting methods are poor.
5. Very little analysis or use is made of the accounting data secured.
6. Either the cost or the accounting system, or both of them, are overelaborate.
7. The accounting results do not reflect actual operating conditions.

Remedy for Weak Financial Control

The remedial course to be taken where the financial control is obviously weak may be stated in a general way as follows:

1. Have an audit made, one purpose of which will be to analyze the accounts and accounting methods as a basis for revision.
2. Let the engineer and accountant work together to determine the feasibility of obtaining costs, of tying-in costs to the accounting controls, of shap-

ing the accounts to reflect operating conditions, and of providing for regular financial and statistical reports to the executives, which shall be intelligible and valuable.

3. With a resultant installation program, approved by the management as a basis, let the accountant develop the detailed forms and methods necessary to accurate accounting records, while the engineer develops the interlocking details of cost, production, labor, material and equipment forms, methods, and records.

This is the phase of the work which is usually most difficult and sometimes the most discouraging. The engineer will have difficulty in working with the accountant because of the differences in viewpoint and in nomenclature. The engineer will find his desire to secure *statistics* sometimes blocked by the accountant's desire to secure penny-accurate *figures*. He will have to place himself in the mental attitude of the executive in determining just what records and reports are most necessary, for very often the company executive will have the vaguest ideas of what is desired. In this work the engineer requires more than technical skill and knowledge—he requires a sound business sense and a broad viewpoint of the business as a whole. He will do well to bear in mind also that these accounting and statistical records will be his instrument in proving the savings resulting from the more purely engineering phases of his work, and that they should be capable of quickly and accurately providing this class of information when it is wanted.

Importance of Co-ordinated Accounting and Statistical Records

There is an old saying that "knowledge is power," and its truth is forcibly proved as one sees the executive power which comes from the recorded information provided by a well co-ordinated system of accounting and statistical reports. Off-hand, some startling examples of waste elimination may be quoted, which have resulted from the mere *recording* of facts for executive analysis. Thus one large saw-milling concern found by the mere recording of material consumption that costs in their box shops were less if they sold all No. 4 lumber for firewood instead of attempting to use it. Another company discovered (when all material was placed under proper inventory control) that nearly $200,000 in salable product was stored around the plant in obscure rooms and corners. Still another company discovered from their material usage records that a certain ingredient was still being used in their product formula (causing an excess cost of about $20,000 per year) although the mechanical processing had been changed several months previously to eliminate its necessity. Doubtless many instances of a similar character will be recalled by the reader.

Often in the work of co-ordinating plant and accounting records it will be found that factory clerks are keeping daily records which never have any use. In one company an entire cost department (four persons) had been compiling partial cost data for over three years, yet this data was never used because the chief accountant "had no use for costs," and closed his books once a year on the basis of a physical inventory, while in his lower desk drawer reposed the fundamental information necessary to perpetual inventories, to accurate monthly profit and loss statements, and to detail costs on all products. The clerical waste of the time of four people for three years was the least of all the wastes, for when these costs were used, and interlocked with the accounting controls, the management cut their inventory investment in half, discontinued several products which had regularly been sold at less than cost, and materially decreased the operating costs of several departments—something that should have been done years before.

Additional Controls for Elimination of Waste

Aside from the executive control which comes as the result of organization definition and rearrangement and as the result of proper accounting and financial-statistical records, there is also the control secured through the more usual engineering improvements. This means the establishing of material records, such as perpetual inventories, purchase records, and usage reports. It means the co-ordinating of production with sales requirements, the possible establishment of sales and production budgets, the proper routing of production and the best utilization of equipment. It means also the control of labor personnel and of labor distribution, and even merges into the factory engineering province of plant layout, power plant requirements, etc. All of these sub-controls must be effective in themselves and must be brought to the executives in their more general phases, as a means of policy-shaping as well as operating control.

Control Must Be Co-ordinated

Only too often, however, each of these sub-controls is regarded as an independent unit, to be brought to a state of theoretical perfection regardless of its influence on other controls or on the business as a whole. This is the fault of the engineer, whose natural tendency is toward perfection of detail. Yet what is the real benefit in reducing direct labor costs 25 per cent if the total direct labor is only 4 per cent of the selling price, while distribution costs are left unchanged at 26 per cent of the selling price? There is need for education of the industrial engineer as well as education of the management. At present it seems that both are too much inclined to judge the value of engineering work on the basis of immediate and provable savings accomplished by each system or operating change. The real test should be as to whether the change has resulted in a better knowledge and control over some phase of the business. It must be assumed that with full and correct knowledge of all phases of the business a general manager may make that business profitable. If this assumption is wrong, then the remedy lies in providing a more competent manager, or if the manager is not at fault, the substitution of some more profitable line of business.

Cost Accounting for Shop Work

Correct Costs at Little Expense—II

By GAYLORD G. THOMPSON

Manufacturing Analyst, Cutler-Hammer Manufacturing Company

IT is practically impossible to establish a standard dividing line between raw stores and finished stores that would apply universally to all types of manufacturing concerns.[1] For the small concern, there is no necessity of creating two separate divisions of stores. Profits can be calculated just as well without these divisions, and at the same time overhead expenses, involved in maintaining records of these classifications, are reduced.

By having only one stores account the crediting of costs of goods sold is done with less entries. This reduction of work insures greater accuracy in computing the value of stores under the perpetual inventory system.

The keeping of perpetual inventory records in a small concern is in the majority of cases too expensive to maintain in proportion to the benefits derived. However, in order to provide a monthly statement of profits and stores balances, a method of stores control must be established from which these statements can be correctly and quickly compiled.

LEDGER COST SHEET

NAME Straight Valve Body — PART NO. 30

MATERIAL Cast Brass 1 lb. — USED ON #400 — PATT. NO. 30-F

OPERATION	DATE	ORDER NUMBER	QUANTITY	PIECE RATE	UNIT LABOR COST	SUMMARY	COST
#1 Bore & Tap one end for 1/2" pipe	4-1-24 4-20-24	2500 2631	500 300	1.00	.01	Ord. No. 2500 Date 4-1-24 Material	.32
						Total Labor	.09
						Factory Overhead	.063
						Factory Cost	.373
						Gen. and Adm. Overhead	.054
						Total Mfg. Cost	.427
#2 Bore & Tap other end for 1/2" pipe		2500 2631	500 300	1.00	.01	Ord. No. 2631 Date Material Total Labor Factory Overhead Factory Cost Gen. and Adm. Overhead Total Mfg. Cost	
#3 Bore, face, seat, turn, and thread for stem.		2500 2631	500 300	2.00	.02	Ord. No. Date Material Total Labor Factory Overhead Factory Cost Gen. and Adm. Overhead Total Mfg. Cost	
#4 Polish		2500 2631	500 300	4.00	.04	Ord. No. Date Material Total Labor Factory Overhead Factory Cost Gen. and Adm. Overhead Total Mfg. Cost	
#5 Nickel Buff (Plate)		2500 2631	500 300	1.00	.01	Ord. No. Date Material Total Labor Factory Overhead Factory Cost Gen. and Adm. Overhead Total Mfg. Cost	

FIG. 2 LEDGER COST SHEET

The first step is to place a man in charge of stores, preferably one who is somewhat familiar with both the products and the method by which they are fabricated, and who is reasonably intelligent. Let him manage this division as a retail store proprietor, in that he makes out all requisitions for goods taken from stock as required by the shop, gives proper notice of low stock for purpose of replenishment, and acts as receiving clerk. The work of a storeskeeper in a small concern is not so congested but what his time can be put to good use in performing the duties outlined above, as well as in maintaining proper location of stock, and keeping records of stock on hand in so far as quantity only is concerned. This does not mean perpetual inventory in dollars and cents.

A simple method of keeping a record of stock on hand is to provide a tin card-holder to fasten to each bin or receptacle containing stock. This holder is of a size to hold a plain 3 x 5 in. card. On each card are written the name and part number of the article which is kept in that respective bin. The storeskeeper counts and enters on this card the number of parts on hand at the time he is receiving or delivering the units. No special ruled card is necessary for the purpose. When the card becomes covered with notations, a new card is inserted. To this extent a perpetual inventory of goods on hand is maintained, and anyone can see at a glance the quantities of each item which are available for immediate requirements.

Purchase Orders

There is no need to illustrate a form of purchase order blanks, as the design of the form has no direct effect on the method of cost keeping described in these articles. When a purchase order is issued, three copies should be made, preferably of three different colors, as for example: white, the original; pink, the duplicate, to go to the stores clerk; and blue, the triplicate, to remain in the purchase files for checking with invoices.

At the time the purchase order is made out, the account number to which the goods are charged when received, is entered on the pink and blue copies. When the goods are received by the stores clerk, the account number appearing on his pink copy of the purchase order tells him whether the goods are to be carried in stores or delivered to any certain department, as shown in the classification of accounts. If the goods are delivered direct to a department, the one in charge of the department receiving the goods, signs the stores-

[1] See MANAGEMENT AND ADMINISTRATION, November 1924, p. 517, for the first article of this series.

keeper's copy of the purchase order as a receipt. In either case the storeskeeper notifies the purchasing agent, who makes notation on his blue copy as to the date on which the goods were received.

When invoices are received, they are turned over to the purchasing agent for his O K. At the same time he enters on the invoice the account number to which the goods are to be charged, as shown by the copy of the purchase order. By this method, the bookkeeper is guided in making proper entries to harmonize with the factory disbursements and records.

Detail Costs and Operations

The assignment of identification numbers to parts manufactured is one of the most important steps that can be taken to insure correct identification of units for cost records and manufacturing. It eliminates the possibilities of errors caused by the many different names given to the same unit. Then, again, the annual inventory is made much easier for pricing where part numbers are given, and time is saved because of doing away with the detailed description of parts.

About the simplest method of applying part numbers is the straight numerical system. The part numbers used to identify assembled units can have an asterisk or star preceding the number, but at all times should continue in numerical sequence. For example, number 300 might identify a valve body, and star number *301 a complete valve assembled. However, if the valve has a catalog number, the catalog number should be used. The star numbers should be confined to only such assembled units as bear no catalog number, or to minor assembled units which are carried in stock for future use on major assembled units.

After identification or part numbers have been applied, the next step is to provide a method of keeping a record of manufacturing operations involved in making each part. Assuming that part number 30 is a valve body which is to be machined, polished, nickel-plated, and nickel-buffed, and referring to the Ledger Cost Sheet shown in Fig. 2, it will be seen how the operations are listed on the sheet for detail costs. The space left between the listing of each operation, in the columns at the left, is for the purpose of allowing room for entering the costs of the various operations performed on different orders. The amount of space to reserve, can be left to individual judgment as circumstances require.

It will be noted that under date of 4-1-24, order number 2500 was issued for manufacturing 500 valve bodies number 30. This order number and date of issue were entered on the sheet at the time the order was made out. By doing this a record is had of all outstanding orders in the shop. Order number 2631, issued on 4-20-24, is an example of such an outstanding order and shows that no labor time has been received from the shop to apply to this order.

When order number 2500 was completed, labor costs, etc., were entered, and the summary filled out as shown under date of 4-12-24 in the first block of the summary section. The piecework rates are always posted in red ink. The entries in the ledger cost sheet are made from the form known as the Order Cost Record, which will be illustrated and explained under the subject of "Issuing of Factory Orders".

In the summary on the ledger cost sheet, Fig. 2, two main costs are shown, known as "Factory Cost" and "Total Manufacturing Cost". Factory cost does not include general and administrative overhead. It is the figure used by the factory in making charges and credits between various departments, and is also the figure used when pricing cost of goods sold. The reason for using this cost instead of the manufacturing cost will be explained more fully under the subject of "Sales Orders".[2] The manufacturing cost is used only when calculating selling prices and, if desired, for pricing at inventory.

ASSEMBLY SPECIFICATIONS

NAME Valves NUMBER *400, *401, & *402

	SUMMARY	*400	*401	*402			
	TOTAL MATERIAL COST	.425	.435	.426			
	TOTAL LABOR COST	.190	.220	.200			
	TOTAL FACTORY COST	.778	.845	.785			
	MANUFACTURING COST	.920	1.031	.983			

QTY.	NAME	ROUTING	PART NO.	MATERIAL COST	LABOR COST	FACTORY COST	MFG. COST
	Standard Parts						
1	Valve stem	M	21	.060	.020	.100	.120
1	Valve seat	M	33	.010	.005	.020	.028
1	Valve seat washer	Pur.	—	.005	—	.005	.005
1	Stuffing nut	M	23	.020	.015	.050	.062
1	Escutcheon nut	M	42	.015	.020	.055	.071
1	China cross-handle	Pur.	—	.080	—	.080	.080
1	Handle spud	M	16	.010	.010	.030	.038
2	8-32 x 1/4" R.H.B. Mch. screws	Pur.	—	.005	—	.005	.005
	Total cost of standard parts	—	—	.205	.070	.345	.409
	NOTE:- Add cost of either of the following parts, to the above for total cost as per assembly number listed.						
	*400						
1	Straight valve body 1/2"	M	30	.220	.090	.373	.427
	Assembling Cost	M	—	—	.030	.060	.084
	Total	-	—	.425	.190	.778	.920
	*401						
1	By-pass valve body 1/2"	M	31	.230	.110	.420	.510
	Assembling Cost	M	—	—	.040	.080	.112
	Total	-	—	.435	.220	.845	1.031
	*402						
1	Straight valve body 3/4"	M	38	.220	.100	.380	.440
	Assembling Cost	M	—	—	.020	.060	.084
	Total	-	—	.425	.200	.785	.933

FIG. 8 ASSEMBLY SPECIFICATION FORM

Attention is called to the star number *400 appearing at the top of the page of the ledger cost sheet. This number identifies the complete valve specification of which the valve body number 30 is one of the units. The part number on the ledger cost sheet is also the page number, the sheet being arranged for filing in a standard 8½ x 11 in. loose-leaf ring book. This form may be printed the same on both sides but under no circumstances should records be kept of more than one item to a sheet. By adhering to this rule the cancellation of a certain unit will not affect the record of other units, and the canceled sheet can be removed from the book and placed in the obsolete files for possible future reference.

Specifications or Bills of Material showing a list

[2] To follow in the next instalment.

of items constituting a complete assembled unit are essential records where accurate costs are desired. The assembly specification form shown in Fig. 3 is designed to accommodate the listing of parts for one or more different types of assembled units, providing there are standard parts that are common to the different groups.

SHOP ORDER

NOTE - This card must not leave a department until order is finished. Use tracer for partial deliveries.

Date 4-1-24 Part No. 30 Used on 400 Order No. 2500

Name Straight Valve Body ½" Amount 500

Oper. No.	OPERATION	Piece Rate	Pieces Good	Pieces Scrap	Sent Ahead Date	Sent Ahead Amount
1	Bore & tap one end for ½" pipe.	1.00			4-6-24	200
2	Bore & tap other end for ½" pipe.	1.00				
3	Bore, face, seat, turn & thread for stem	2.00				
4	Polish	4.00				
5	Nickel buff (plate)	1.00				

FIG. 4 SHOP ORDER CARD

In Fig. 3 it will be noted that parts for three different types of valves, number *400 for the ½ in. straight valve, *401 for the ½ in. by-pass valve, and *402 for the ¾ in. straight valve, are all listed on this one sheet. Parts listed under the heading of "standard parts" are used on all three different valves. The style of body and the assembling cost are the only items showing a difference in costs. These account for the different assembly numbers or star numbers used to identify the respective complete valves.

The costs of parts are entered from the ledger cost sheet book, a sample sheet of which is illustrated in Fig. 2, cost of valve body number 30. A comparison of the cost of the valve body in Fig. 2, with that of the same body in Fig. 3, will show how the entries are made. The assembling cost records are handled in the same manner as the making of any other part. The star number is used as the part number on the ledger cost sheet where the cost of the assembling operations are kept, and is also used as the part number on the assembly specifications sheet.

After costs of each part appearing on the assembly specifications have been entered, the total costs of the standard parts are footed as shown in Fig. 3. In the lower section of the page it will be seen that three different types of valve bodies are listed, each appearing under the star number that identifies that respective type of valve when assembled with the standard list of parts shown above, and each carrying its own assembling cost. The total cost of the standard parts, added to the cost of the valve body and the assembling cost as shown under *400 in the center of the page, equals the cost of the complete valve as identified by the star number *400. This total cost is entered at the top of the page in the summary section as shown. The same procedure is followed in pricing the other types of valves. There is no further adding or subtracting after entries are made, although the form appears to be arranged for such a purpose.

A feature of this form of specifications is that comparative costs can be seen at a glance and assist in maintaining consistency in differentiation of costs. The form allows for considerable flexibility in that, if at any time a new type of valve body is adopted which will use the same standard parts, all that is necessary is to make another entry the same as shown for the three valve bodies already listed, and the total cost is quickly calculated.

The method of handling different valve costs as described above can be applied in principle to other combinations, such as shower heads, followed with a list of different length short arms, or to a list of shower combination parts, followed by the listing of different sizes of shower curtains. In fact, the application of this method of making up specifications for quick and comparative costs will cover a multitude of combinations characteristic of the plumbing goods line.

SHOP ORDER LABOR RECORD

Operation No. 1			Operation No. 2			Operation No. 3			Operation No. 4			Operation No. 5		
Date	Man	Pieces	Date	Man	Pieces	Date	Man	Pieces	Date	Man	Pieces	Date	Man	Pieces
4-2-24	72	500	4-3-24	72	500	4-4-24	37	200	4-5-24	87	200	4-6-24	77	200
						4-7-24	37	300	4-8-24	87	200	4-9-24	77	100
								500	4-9-24	87	100	4-10-24	77	200
											500			500

Operation No.			Operation No.			Operation No.			Operation No.			Operation No.		
Date	Man	Pieces	Date	Man	Pieces	Date	Man	Pieces	Date	Man	Pieces	Date	Man	Pieces

FIG. 5 REVERSE SIDE OF SHOP ORDER CARD

Issuing of Factory Orders

The classification of order numbers is desirable before manufacturing orders are issued to the shop. It increases simplicity, is of greater convenience, and

~~SHOP~~ ~~PURCHASE~~ ~~CREDIT~~ **REQUISITION**

DATE 4-1-24 ORDER NO. 2500

FROM Stores # 10

PART NO	PATT. NO.	AMOUNT	DESCRIPTION	AMOUNT DELIVERED	DATE
30		500	Straight Valve Bodies rough	500	4-1-24

CHARGE #12 SIGNED J. S. R. STORES

SIGNED ENTERED

FIG. 6 REQUISITION FORM

provides for better distribution. An example of classified order numbers is given as follows:

1 to 2999 Shop production orders.
3000 to 4999 Foundry production orders.
5000 to 5999 Tool-making orders.
6000 to 6999 Pattern-making orders.
7000 to 7999 Miscellaneous expense orders.
8000 and up Sales orders. Also used by the shop as manufacturing order numbers where the sales order calls for special work.

Where labor and materials are used by the shop for maintenance or repair work, the account number appearing in the classification of accounts is used. The account number selected, however, must be the one appearing under the department to which this expense is to be charged.

When a shop production order is issued, a shop order card is filled out as shown in Fig. 4. The information appearing on the card regarding operations, piece rates, etc., is copied from page 30 of the ledger cost sheet book. The page number, it will be remembered, is also the part number. The order number and date of issue are entered on the ledger cost sheet at this time because, as previously explained, it is necessary to maintain a record of all outstanding orders in the shop for the manufacture of any unit. The shop order as shown in Fig. 4 was copied from the sheet illustrated in Fig. 2. No cost records, however, appeared on this sheet under order number 2500 when the order was first issued.

Fig. 5 shows the reverse side of the shop order card illustrated in Fig. 4, and is provided for the convenience of the foreman in keeping a record of the number of pieces finished on each operation by the various workers, as recorded on their time tickets.

After the shop order card is filled out, it is given to the stores clerk who makes out the requisition shown in Fig. 6, filling in the credit account number 10,[3] which is for Stores, and the charge account number 12, which is for Work-In-Process, also other information as shown. The requisition is then forwarded to the cost clerk for pricing. The shop order card is delivered with the materials to the shop.

The requisition form as illustrated in Fig. 6 is designed for serving a combination of three purposes, namely, shop requisition, purchase requisition, and credit requisition. The individual purpose of the requisition is known when two of the three names are scratched out as shown at the top of the illustration.

When the order card and the material are received by the shop, and part of the order is completed to be sent along in advance of the rest of the order, the foreman sending the material ahead must fill out what is known as the "tracer card" shown in Fig. 7. If there are other operations to follow, these must be written in by the foreman, each operation bearing the same operation number as that appearing on the shop order card. The date and the amount sent ahead are also entered in the "Sent Ahead" column of the shop order card. This record serves as an index to all tracer cards that may have been issued, as well as assisting in the checking up of the total number of pieces sent to the stores.

The tracer card acts as an order for the next department to finish the balance of operations, and also gives information as to how many parts are to follow. In Fig. 7 the 200 pieces shown as sent ahead happened to be completed, and consequently were sent direct to the stores. The shop order card should never leave a department until the entire order is finished there. It is finally sent to the storeroom, signed by the stores clerk, and forwarded to the cost clerk for checking and pricing.[4]

PART ORDER SENT AHEAD

Date 4-6-24 Part No. 30 Amt. on Order 500 Order No. 2500

Name Amount 200

Oper. No.	OPERATION	Piece Rate	Pieces Good	Pieces Scrap	Sent Ahead Date	Sent Ahead Amount
	To Stores		200			
	Received in Stores 200 pcs. 4-6-24					

FIG. 7 TRACER CARD

The reverse side of the card is the same as Fig. 5, except that the heading is "Order Labor Record".

[3] These account numbers are listed on p. 518 of MANAGEMENT AND ADMINISTRATION for November 1924.

[4] This article will be completed in an early issue.

Carrying Mail Mechanically

By L. A. WILSON

Manager of Mailing Department, General Electric Company

WHEN a manufacturing plant covers a considerable area, quick and accurate delivery of mail becomes a serious problem. The usual messenger service is likely to prove inadequate when the routes covered are of considerable length. Either a very large number of messengers must be employed or service is slow and inefficient.

At the Schenectady Works of the General Electric Company this problem has been solved by supporting the messenger service with a mechanical system that delivers mail at three terminals located at strategic points in the plant. All mail from outside the plant is received at the central office in Bldg. 2, shown on Fig. 1. This, together with mail collected in the office buildings adjacent to the central office, is sorted and packed in mailing tubes about 4 in. in diameter and

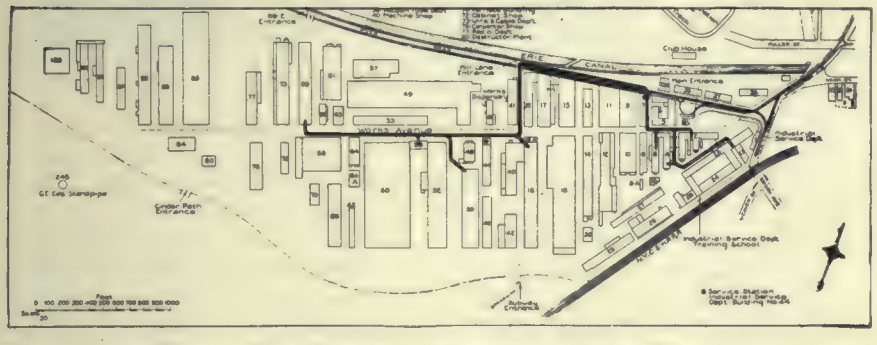


FIG. 1 MAP SHOWING LOCATION OF MAILING TUBES

2 ft. long. The number of pieces that can be packed in a single tube varies greatly.

The packed tube is placed in the conveyor, which is a vacuum system, and is carried to the first substation in Bldg. 7-A. Here the tube tumbles out in front of the man in charge, who looks at its destination tag. If it is addressed to another station he replaces it in the conveyor and sends it on to its destination. If it is addressed to his station the contents are emptied out and sorted for distribution by the messengers.

The same procedure is followed at all stations. Mail collected by messengers operating from each station is sorted and forwarded to the station nearest its final destination. Tubes are continually passing in both directions through the conveyors. In the factory, hourly messenger service is maintained. In order to have a "closing" time for each hour's mail, each station sends to each of the others a special colored tube which signifies that the contents are the last to be included in that mailing. As soon as final tubes have been received from all other stations, the messengers start out to deliver the mail.

In the office buildings, where the amount of mail is considerably larger than in the factories, half-hourly service is maintained. In the factory the route of each mail-carrying messenger requires about 40 min. The remaining time is spent in sorting both incoming and outgoing mail, and resting. The messengers are checked in and out.

Use of the mechanical conveyor not only greatly speeds up mail delivery, but has provided a means by which messenger service throughout the plant has been co-ordinated and made regular.

Why Is an Office Manager?

By E. H. FISH

THE first man whom I ever met under the title of Office Manager proved on longer acquaintance to be the janitor of the office building, to whom had fallen the duty of pasting all memos, orders, etc., relating to the office, in a book and keeping the book accessible to everyone who had the curiosity to look in it. Since then I have met every shade of office manager up to the man who really manages an office. I fear that there are more men who use the title than there are men who manage offices. The title seems to be applied to any minor executive who has rather indefinable duties.

Beginning with the janitor aforesaid, the next stage seems to be the man who stalls off applicants for jobs, letting only a few filter through to see department heads who really want to hire, and who have no poor relations for whom jobs must be provided.

Then there is the errand-boy type, who orders everything needed, from paper clips to desks and typewriters. To be sure, he usually orders through the purchasing department, but after a time even that department gets tired of changing his specifications and buys what he wants as a matter of course.

Then still rarer is the man who not only sees the applicants for work but who makes it his job to know where there are suitable people who can be hired in an emergency for any place in the office, hires them and trains them for their work. He stands ready to straighten out any jams into which the help get with their superiors, and sees that the deserving ones are the ones that get promotions.

When this stage is reached we begin to hear from employees who quote the Biblical injunction about serving two masters, and we hear also from department heads who want to know "Who's boss here anyway?" It does require pretty careful work on the part of the office manager and entire co-operation on the part of everybody else to make this kind of office management go, and go smoothly. The fact is that in 9 out of every 10 places the office manager, after bucking the combination for a while, deteriorates into very much of a "Yes man" who keeps entirely still unless he can coincide.

The first aid to harmony is a very distinct and clearly defined division of duties, issued, or at least O K'ed by the highest official of the company and lived up to by all. Offices in which each individual is told his job by the head never run smoothly, because

it is impossible to tell a man about his job in private without his thinking that he has more authority than it is intended he should have. And a chart of the organization that is not lived up to is as bad as an unloaded gun. It is liable to go off with a bang in the hands of the very man who thought he had drawn the charge.

The fact that the company has appointed an office manager does not increase the number of applicants for jobs nor does it improve their quality. Department heads are apt to think that, having been relieved of looking up suitable help, by some hocus-pocus there will immediately come to them some superior beings who will need neither discipline nor training. To be sure, if the office manager is on the job and has the right backing, in a year or two he will have changed the personnel of the office by imperceptible degrees so that it is much nearer the ideal than it was before, but if he tries to do it all at once the only sure thing is that there will be one more office manager looking for a job for himself than there was before.

In his search for the right help he is handicapped by the fact that the best help are usually employed. If he hires them away from local firms there is sure to be a howl, because these other firms threaten to make reprisals. So he tries to get them from out of town, the farther out the better. Even then it behooves him to find out what clubs the boss belongs to. He may find that it is all right to hire from any firm in Bridgeyork except the Blank Manufacturing Company, but that the treasurer of that firm and the president of his own company belong to the Grand Order of the Sainted Whiz-Bang and it simply will not do to help any of the other fellow's help to get a better job.

After butting his head against a few of these stone walls, he probably gives it up as a bad job and either drifts with the current, or achieves the great idea of hiring them young, keeping them, and training them up the way they should go. This in theory and in the long run is by far the best, but it lacks elasticity. It can only be done where the management is fully sold on the idea, enough so to make them willing to carry along through dull times enough young men and women to carry the peak load which comes in flush times. Once these people get away from the firm, they are most likely lost for all time. Very few ever come back and give or get satisfaction.

Vacuum Cleaning With Compressed Air

A METHOD of providing a vacuum cleaning system from equipment to be found in nearly every factory has been developed by employees of the Southern Pacific Railroad and has proved entirely practicable for periodic cleaning of the company's passenger equipment. It consists of a "Y" mounted upon a tripod. One inlet is connected by hose to the plant's compressed air line. The outlet discharges into the open air or may be fitted with a bag to catch the collected dirt. The second inlet is connected by a hose to a standard vacuum cleaning appliance, a short piece of pipe, or whatever will best meet the necessary cleaning requirements.

When compressed air is turned on, its passage through the "Y" sets up a vacuum in the second inlet

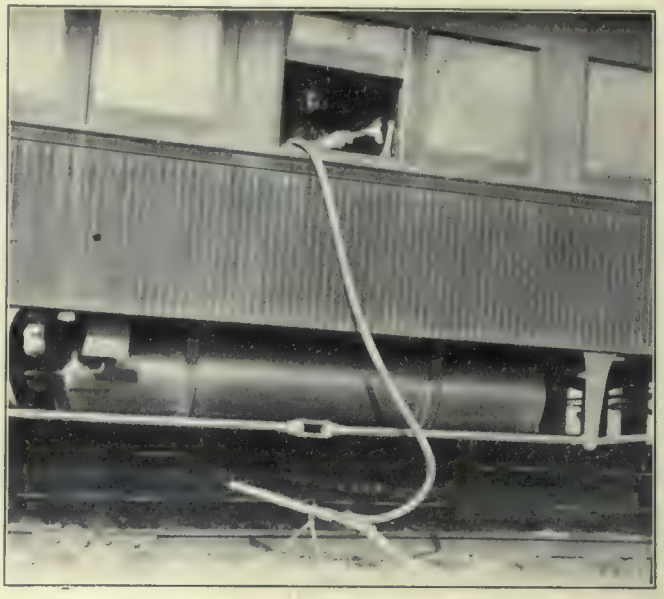


FIG. 1 VACUUM CLEANING WITH COMPRESSED AIR

and thus provides an efficient cleaning system. It is particularly efficient in cleaning motors, machine tools, and similar equipment, which present obstacles to ordinary cleaning methods. There is practically no expense in constructing the equipment, and the sole operating cost is the cost of compressed air.

By installing a valve in the "Y" the compressed air can be diverted to the cleaning nozzle so that either blowing or suction can be used, according to the requirements of the cleaning jobs.

Preventing Defacement of Property

By J. HORACE VAN NICE

THE problem of preventing writing and drawing on washroom walls has long been before building superintendents and other officials charged with plant maintenance. It has been solved for one large concern after long experiment. Finding that the best policy was to make defacement as nearly impossible as circumstances would allow, experiments with all known wall finishes were conducted until it was discovered that several finishes were practical for factory use, since they were not easily defaced by marking or drawing, yet their really fine appearance appealed to the employees.

Cloth coverings were found to be quite satisfactory, due to the fact that the roughness prevented marking with pencils, which was the usual method. But color plays an important part in the successful use of cloth. Painting the cloth in dark colors, preferably green, helps greatly, but ordinary flat colors fill the pores and provide body for working. Dark kalsomines are decidedly discouraging to the would-be artist—much more so when used on cloth, rough plaster or similar

material than when used on any smooth surface.

Where little light can enter, dark walls are to be avoided. In such places it was discovered that the finest wall covering consisted of copper, zinc, or tin heavily lacquered. This type of covering is somewhat more expensive than other finishes, but is also much more permanent.

Kalsomines are entirely dependent upon the surface. The very rough surfaces are poor because they catch dust, and are extremely difficult to finish; smooth surfaces tempt the pencils. Practically the only satisfactory way to use kalsomine is with cloth, except for ceilings and other surfaces that cannot be reached by the hands of the offenders.

Glossy paints, if of dark color and if not too firm when dry, resist working for some time but will finally give way. The only remedy is to add a coat periodically, say once every three months. In fact, such a practice is desirable with nearly any finish used.

The best finish was found to be a brightly glazed porcelain tile, but of course the element of expense enters largely into such a consideration. However, where upkeep is concerned the tile is by far the cheapest in the long run, for all it ever needs is a periodical washing.

Reducing Die Costs

By ARTHUR L. GREENE

Buffalo Forge Company

THE shop management frequently encounters difficulties in satisfying the demand for both economy and time saving in production. In some cases, for example, the necessarily limited demand for a product will not warrant the expense attached to the machining of a steel die for quantity production; at the same time, the demand may be sufficient to make the method of built-up construction not only very expensive, but a time-losing proposition as well. In instances of this kind, the difficulty can be solved at times by making the dies of cast iron rather than of steel. In this manner the high cost of machining is greatly reduced and at the same time a die is produced that will take ample care of the manufacturing needs. This is true particularly of the larger size dies, since the saving in first cost is usually proportionately greater than the increase in size.

FIG. 1 CAST-IRON DIE FOR STAMPING STEEL HEARTHS

An example of the above is shown in the accompanying illustration of a cast-iron die designed and manufactured by the Buffalo Forge Company, for stamping the steel hearths used with their general repair forges. The forge hearth has an overall size of 24 in. by 30 in. and is rectangular in shape. The depth is 5½ in. On two opposite sides is a cut-out section. The four upper corners of the hearth have a 3-in. radius and the bottom corners a 1½-in radius.

It has been the practice up to very recently to make these hearths or bowls of built-up construction. The great amount of labor and time entailed, however, made this procedure a costly one. By employing a die, however, all of the individual operations are eliminated; a single down stroke of the press produces the finished hearth.

The new forming die is built-up of six castings made of close grain iron; three castings comprise the female section and three the male. The castings for the latter consist of a flat plate 2 in. thick with the punch fastened to it with eight bolts, while the pressure ring fits over the punch. The female section consists of a flat plate 1½ in. thick to which the forming die itself is fastened. The ejector plate fits inside the die. The reason for building the die in two sections was due to difficulties in machining when made in one solid casting. A one-piece section could only be machined with a vertical mill and this required the expenditure of considerable time and labor. By building it in two sections, the machining operations entailed were of the simplest kind. Another advantage to be noted is the ease with which this die can be enlarged if desired, without discarding any of the old castings.

At each corner there is a steel insert fastened in the die; these inserts were bored and turned in the lathe and pack hardened. The die was then put on a boring mill and the corners bored out and the recess cut for the steel insert. These inserts are held in place by two bolts each. Because of the great wear and strain on the corners of the die, it was deemed advisable to have these inserts in order to prolong the life of the apparatus. After the inserts were fitted, the die was put on the planer and the sides finished. There are also two steel inserts in the die at the point where the cut-out sections in the sides of the hearth are placed. The sides of the bowl are made with a taper of 5 deg. in order to facilitate stacking. The stock used is heavy gage nickeled steel plate.

A single acting press is used for this operation; an air pressure of 40 lb. is used beneath the press to keep the stock from wrinkling. It is estimated that this die will be good for 1000 pieces before repairs are necessitated. In addition to having a die at a reasonable cost which will save considerable time and labor charges in production, the manufacturer is now enabled to produce a hearth that is not only more durable than the older design, but one that is vastly improved in appearance as well.

THE EDITORS' PAGE

Management Simplified

SIMPLE solutions of problems do not come quickly or easily. Just why this is so may be difficult to explain, but it seems to be a universal truth. Yet the advantages of simplicity are so real that just now, when scientific management has become of age, it is very much in order to search for management simplified. Fortunately, the search need not be long. Under the auspices of the American Society of Mechanical Engineers, which gave to manufacturing industry in 1903 Taylor's great paper on "Shop Management," a paper was presented in 1924 entitled, "Design, Manufacture and Production Control of a Standard Machine."

This paper by Ralph E. Flanders might better have been entitled, "Management Simplified." It is the story of an evolution. Twelve years ago his company started an extensive campaign to improve methods of doing work and to control its progress. This was scientific management of the 1912 variety. Some five years ago this development was pretty well completed and an attack on overhead begun. The reason for this change was due to the operation of the law of diminishing returns which brought out these facts:

> The direct labor cost of product was small.
> The material cost of product was much higher.
> The manufacturing overhead was largest of all.

In fact, the relative proportions of these expenses were such that, if the item of direct labor cost could have been completely eliminated, the profits of the business would not have been extraordinary. Many a firm has faced this same situation. In some cases, the management problem involved has been appreciated and a solution found. In others the problem has been disregarded, and there have come disaster and bankruptcy.

Mr. Flanders describes in detail the way in which they solved their difficulty. It was a true process of simplification which, as he puts it, sought to "avoid difficulties rather than overcome them."

He is now operating without:

> Stockroom records
> Central control
> Physical arrangement according to process
> Detail costs
> Incentive wage payment plan
> Control records

In this showing alone there is ample cause to refer to the development as a simplification of management. For the methods he is using, the reader must be referred to the paper.

A most homely and practical bit of advice Mr. Flanders puts in this way:

> A visual estimate, it may be said, is a quite useful and revealing practice, and every shop manager who has not acquired the habit should contract it at once. It should be made with a view to criticizing the management rather than the workers.

This advice is of the order of a rather familiar saying that every once in a while it is wise to "get off your horse and watch yourself ride." When this advice which Mr. Flanders took to himself begins to be followed, there will be more simplified management.

Scientific Foresight in Industry

COULD we foresee the course of business, it is obvious that its greatest risks would be removed. No manufacturer would overproduce in the face of a diminishing demand for his product; no manufacturer would reduce production if he saw before him orders beyond his capacity to fill, and this anticipation of the trend of business is just what modern scientific forecasting attempts to give.

Does it give it? It does—imperfectly at times, at other times even erroneously, but in the main with fair accuracy, and, as its methods are better understood and further developed, this accuracy will be increased.

In another column, Mr. Barber in his article "Forecasting Your Industry's Cycle" describes in detail forecasting methods employed in the Walworth business. In the conclusion of this article, taking the volume of orders for illustration, he shows by diagram how well the forecast volume matched the actual volume. As stated by Mr. Barber:

> The figure given shows over a period of several years the actual performance against estimated performance. It checks up the kind of advice forecasting gave us as a basis for planning the quarterly production policies. To catch the significance of the comparison, it will be realized that, in all forecasting, there is always the necessity of determining future probabilities from three viewpoints: First, as to the probable direction of the future trend; second, as to the time of change in trend; and, third, as to the extent of the movement in its general direction.

To this Mr. Barber adds:

> Even this sort of comparison is often inadequate to tell the whole story. In the appraisal of the effectiveness of "forecasting methods" as against "no forecasting methods" the true comparison should be of the actual results obtained against those that "might have been," had judgment been affected only by "boom" propaganda. Particularly at the very peak point of the business cycle just prior to decline, there seldom fails to be generated a large store of optimism concerning the future.

Modern forecasting methods are too new to have come into general use, but where they have been intelligently and scientifically employed, the results are as striking as any shown in Mr. Barber's figure. In one recent instance, $20,000 was saved on a single purchase by buying in advance of the rising demand—a rising demand indicated by forecasting charts. In another case, the fluctuating line of labor employment was materially flattened by the predictions of the order forecast. The number of men was reduced well before the lowest depths of depression were reached; men were employed well before the rising tide of orders reached its peak. And at all times production as well as employment was stabilized.

The hesitation to adopt modern forecasting methods frequently found is usually the result of doubt as to their efficacy in the particular industry. There is no reason why forecasting should not be used in every industry. It is a scientific, but also a common-sense, development of business.

Help for the Sales Manager

THE industrial engineer and the accountant have been called upon to "do their stuff" in the management field, the one in producing goods at lowest cost and the other in budgeting finances for economy of funds in manufacturing. The general manager, casting his eye around the circle again to summon another offender to account for needlessly depleting the company exchequer, has lighted on the sales manager as the next one to bring on the carpet.

Now the poor sales manager is up against it. He is dealing with people outside his own plant and he cannot "boss them around" and force them to buy. He is working on the intangibles of human nature and not materials of manufacturing or the mathematics of accounts. He battles with seasons, styles, scientific developments, slick competitors, shipments, snags and snarls of production, and a host of other things which add to the alliterative medley. And yet he must come across with increased sales and at the same time spend less money. How is he to do it?

Fortunately he does not find himself helpless and alone in this quandary. Other men who know his problems, either from their own experience or from that of sales departments with which they have had direct dealings, have found ways to solve such problems. Mr. Barber's article, mentioned in the preceding editorial, and appearing in the present issue of MANAGEMENT AND ADMINISTRATION is one source of definite assistance. The Walworth Manufacturing Company, whose developments are described, has done what is probably the most extensive and successful work ever accomplished along this most necessary line. G. Charter Harrison, from his personal experiences in many plants, writes on other sides of the selling question, explaining, in this case, how standard costs iron out difficulties that otherwise would hit the sales department hard. Finally, W. A. McDermid, who has spent many years on the firing line in getting sales programs across, shows how the sales manager can actually measure his selling and advertising efforts and check up directly on the results accomplished. He points out the fallacy of such a thing as an "average cost" of selling and advertising. He also encourages the sales department with the statement that, where there is a market for a line of goods, the sales results increase in proportion with the effort put forth.

With help like this at hand, the sales manager can prove that he is bringing home the bacon, if he is, or he can find ways and means to bring it home, if his hands are rather empty at present.

The Rehabilitation of an Industrial Nation

THE Great War ended over six years ago, but Germany's economic recovery is not yet achieved. It has been held back by chaotic conditions at home and hostility abroad, and the first real step toward German recovery was the acceptance of the Dawes plan, followed by the successful floating of the recent external loan of 800,000,000 gold marks. Commenting on this loan and its effect on Germany, the correspondent of *The New York Times* writes:

> The novelty and intricacy of the transaction are equalled only by its importance. At once the buttress and keystone of the Dawes plan, it may be taken as marking the end of the semi-chaotic business conditions following the war and as ushering in a period of greater stability and progress.

The very fact that such a loan could be seriously undertaken indicates the waning hostility toward Germany. The prompt absorption of the loan by the investing public here and abroad evidences the willingness of the nations to resume normal relations with Germany.

Nor are there lacking other indications in this country. Close on the German loan comes the announcement of a $25,000,000 corporation organized under the auspices of New York financial interests—The National Acceptance Bank, Inc., and Kuhn, Loeb and Company with Dillon Read and Company and their associates—to aid in financing the rehabilitation of Europe, and especially to provide German industry with the working capital necessary to the success of the Dawes plan.

Of even greater significance is the opening of offices in Berlin by some of the most prominent accounting firms of this country—Haskins and Sells; Price, Waterhouse and Company; Lybrand, Ross Brothers and Montgomery—so that, as explained by Mr. Lybrand, of the last-named firm, "American business interests may obtain accurate statements of the resources and obligations of prospective German borrowers."

The bitterness engendered by the war has stood too long in the way of world progress. It should have been sooner brushed aside. These indications that the resumption of normal relations among the former belligerents is merely a question of time—and a short time at that—are, therefore, very welcome.

INDUSTRIAL EQUIPMENT
NEWS FOR THE MANAGEMENT

This department is conducted to give our readers essential facts regarding items of industrial equipment recently placed on the market, that may be used to increase production or lower costs. The editors will be glad to furnish additional information about any item. All information given is obtained from reputable manufacturers, and MANAGEMENT AND ADMINISTRATION accepts it as reliable.

Electric Hoist

A SMALL capacity electric hoist has recently been placed on the market by Roeper Crane and Hoist Works. This Type R hoist is worm geared, with the worm above the gear. An automatic stop of the trip-lever type provides upper and lower limit protection. Use of worm drive makes a load brake unnecessary. A mechanically operated jaw brake, acting in series with the controller, brings the motor to a quick stop and prevents drifting of load after power is shut off.

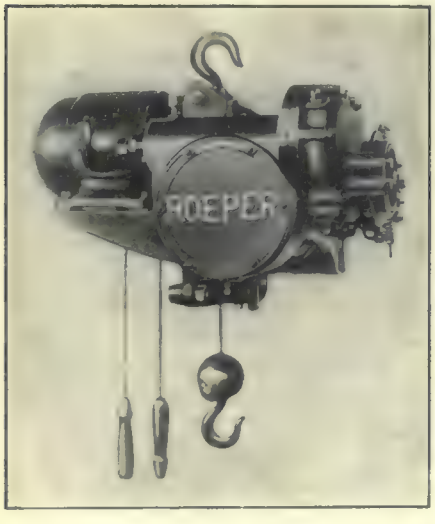


FIG. 1 SMALL CAPACITY ELECTRIC HOIST

Controllers are simple speed drum type. Push button control can be furnished. Besides the hook suspension shown in the illustration, hoists can be furnished with plain or geared I-beam trolleys with roller bearing wheels, or for direct connection to any standard trolley for flat rail or special track. Capacities furnished are 500 lb., 1000 lb., and 2000 lb. They are equipped with a single strand of non-twisting type hoisting cable.

Stacking Tructor

AN electric elevator tructor for transporting and stacking bulky cylindrical and rectangular loads has just been developed by The Elwell Parker Electric Company. The tructor handles rolls of fabric, carpet, linoleum, rubber stock, steel, newsprint, and barrels, bales, boxes, textile beams, etc. It automatically picks up its load in any position and stacks either vertically or horizontally, as desired. The elevator raises the lower end of the load up to an elevated position of 6 ft. Thus, material 6 ft. high can be stacked, end on end, to 12 ft. heights. This method saves much valuable storage space, eliminates the double handling by the cumbersome block and tackle method, results in the conservation of time and labor, and avoids the usual hazards attendant to hand handling.

The unit consists of an elevator tructor with a revolving apron or cradle for securing the load at the end of the platform, the cradle being built to suit. The load is raised or lowered by operating the elevating platform while the cradle is revolved to any position, from the horizontal to the vertical, by means of the additional hoisting unit. The two hoisting units for operating the elevator and revolving the cradle are standardized with interchangeable parts. All power for the equipment is supplied from one central storage battery carried in the battery compartment, with individual controllers for the lifting, revolving, and driving mechanism. The standard Elwell-Parker safety devices are installed along with some additional ones covering the new operation.

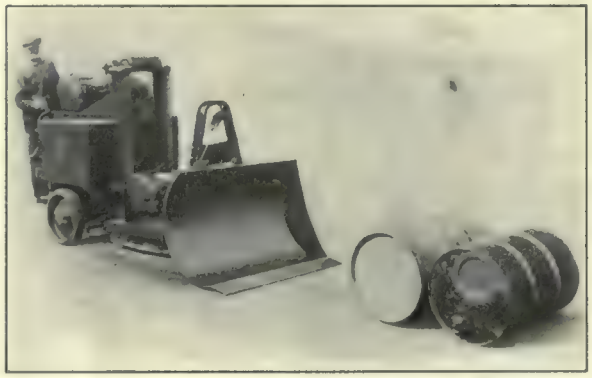


FIG. 1 ELECTRIC ELEVATOR TRUCTOR FOR TRANSPORTING AND STACKING CYLINDRICAL AND RECTANGULAR LOADS

One man operates the equipment and has clear vision of the forward part of the unit at all times.

Air Compressor

A NEW line of multistage, centrifugal compressors, designed to supplement the line of single-stage machines recently developed, is now being marketed by the General Electric Company.

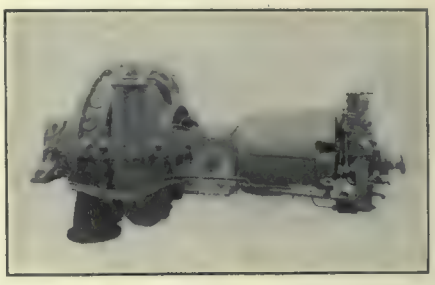


FIG. 1 MULTISTAGE CENTRIFUGAL COMPRESSOR

These compressors have been developed for furnishing various volumes at higher pressures than ordinarily obtained with single-stage machines. They will find their greatest applications in blowing blast furnaces, Bessemer converters, gas boosters, gas exhausters, in pneumatic material-handling systems, in the agitation of liquids, etc.

The line covers water-cooled machines designed to deliver volumes of from 3000 to 60,000 cu. ft. per min. at pressures up to 30 lb. or more; and also two types of miniature self-cooled machines designed to deliver volumes of from 250 to 1400 cu. ft. per min. at pressures of from 2 to 6 lb. All types are to be equipped with either motor or turbine drive.

Among the advantages claimed for the new compressors are higher efficiencies, simpler and stronger construction and minimizing of mechanical difficulties. A larger cooling capacity is expected to bring about greater efficiency, the conversion passages having been improved and the interstage

passages simplified. Each complete unit has four bearings, with an automatically lubricated flexible coupling. In addition to these changes, all the governing devices for these machines have been improved.

Angular Transmission

A DEVICE that is capable of transmitting power between two shaft ends while maintaining a uniform angular velocity ratio of 1 to 1 was recently placed on the market. The transmission is applicable to any shaft angle up to 90 deg. or more. The bearings may be so mounted that one of the shafts can make an angular sweep of 180 deg. or more without affecting the relative angular velocity between the two shafts. It will also transmit motion between two parallel shafts whose center lines are some distance apart.

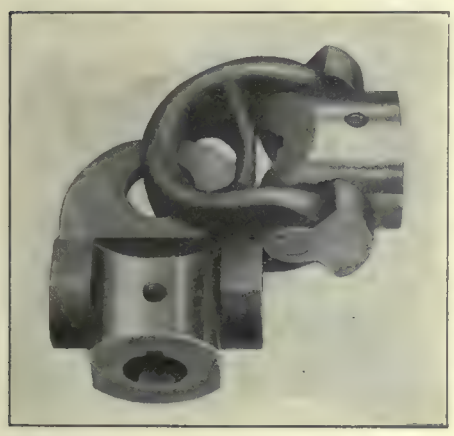


FIG. 1 AN ANGULAR TRANSMISSION DEVICE

G. M. Bartlett, who is marketing this transmission, claims that it is noiseless in action, strong and durable. It is flexible enough to work smoothly when the center lines of the shafts do not lie in the same plane, or when either the driving or driven member is not strictly at the specified location on the shaft. Standard sizes include shaft diameters from 7/16 in. to 2½ in. and maximum hp. per 100 r. p. m. from 0.10 to 12.50.

Foam Fire Engine

A FOAM fire engine that will deliver foam for 3½ hr. at a pressure varying from 55 to 30 lb. per sq. in. has been developed by Foamite Childs Corporation. It is a 50-gal. portable engine and has been approved by the Underwriters Laboratories as effective on both class A and class B fires. In this Type F M engine the two solutions

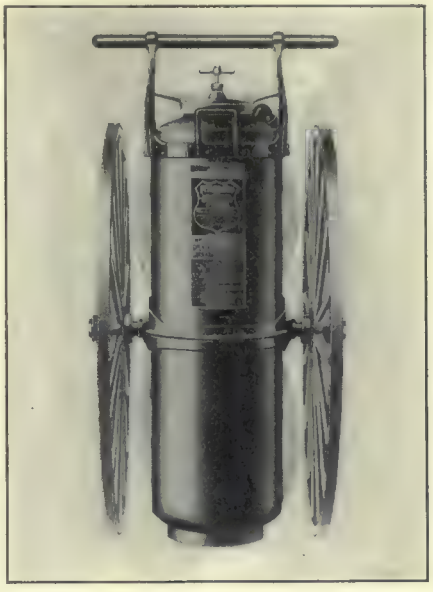


FIG. 1 PORTABLE FOAM CHEMICAL ENGINE

are stored in separate tanks within the engine shell. A system of baffles, orifices and pressure-equalizing tubes serves to control the flow of the two solutions into the mixing chamber.

Because of this measured flow of the two solutions, initial pressure is somewhat less, but effective pressure is maintained considerably longer than was possible with the old style foam engines in which the entire volumes of the two solutions were mixed almost instantaneously when the engine was operated. In comparative tests of the two engine types, made under identical conditions, the old style engine reached the end of its effectiveness after 2 hr. operation, during which the pressure dropped from 70 to 18 lb. per sq. in.

Safety Switch

THE TRUMBELL ELECTRIC MANUFACTURING COMPANY is marketing a small switch for use with small motor installations or on lighting

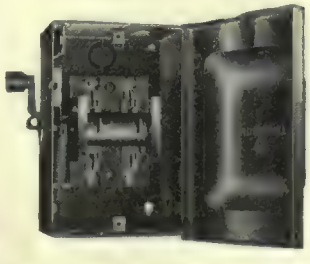


FIG. 1 SMALL SAFETY SWITCH

circuits. It is 5¼ in. wide by 8 in. long and has safety features. Interlocks make it impossible to open the cover while the switch is on. The fuse block is over the switch for ready access for testing. It is reversible so that connections for line and load can be made at either top or bottom. When several small motors are to be grouped under one set of fuses, the switch can be used as a no-fuse switch by removing the switch block.

"Multiplex" Calculating Machine

THE DALTON ADDING MACHINE SALES COMPANY is marketing a calculating machine which will perform many useful operations. Some of the more novel of these are: add 2 sets of figures either in the same or separate columns; perform multiplications so that separate products of each multiplication and the combined product of all are printed automatically; add and subtract simultaneously in a single operation; subtract directly by pressure of a key.

The various kinds of computations are controlled by keys and levers adjacent to the 10-key keyboard. Some of these are: correction key, non-add

FIG. 1 MULTIPLEX CALCULATING MACHINE

key, multiple key, multiplex lever which controls all the adding-calculating mechanisms, non-print key, total and subtotal keys, back space key, and subtract key. By proper manipulation of these controls it is possible to secure separate totals and accumulated total of totals of addition, subtraction, or multiplication operations; to add and subtract at the same time securing totals of both added and subtracted amounts and net total; and many other operations of similar complexity. The capacity of the machine is 999,999,999 in each of its applications.

Elevating Platform Truck

AN elevating platform truck which has a height of 17½ in. from the floor when the platform is down and 22 in. when it is raised, has been developed by Crescent Truck Company. The rear wheels are 15 in. diam., giving a clearance of 6 in. underneath the platform. All tires are 5 in. wide and the truck has a lifting capacity of 6000 lb.

FIG. 1 ELEVATING PLATFORM TRUCK

Wheels are equipped with Timken Roller Bearings and the driving unit with S. K. F. ball bearings. General Electric Motor with Cutler Hammer controller is used. Loading platform is 70 in. by 26 in.

Shop Equipment

SEVERAL items of steel shop equipment have been placed on the market by David Lupton's Sons Company. Steel shelving made in stock heights of 7 and 8 ft. with 12 and 18 in. depths provides easily erected and easily removed or adjusted display space. Shelves can be adjusted up or down in ½-in. increments.

FIG. 1 PRESSED STEEL BENCH LEG

Most good workbenches owe their usefulness to the legs they rest on. A pressed steel bench leg which is strong and light is shown in Fig. 1. It is 31 in. high, without bench top, and can be bolted to the floor. A self-contained shelving unit that can be moved about without dismantling and whose bin arrangements can be altered at will is another product. They can be furnished in 12 different arrangements of bins and shelves.

A steel bench drawer and tray which can be attached to workbenches and tables affords a safe place for workmen to keep their tools. Two sizes of drawers are available, 14 in. wide, 5 in. high, 18 in. deep, and 14 in. wide, 6 in. high, 24 in. deep. They are made of sheet steel and furnished with cylindrical locks.

Air Washer and Cooler

A DEVICE that washes, purifies, humidifies and cools air, combines a fan and washer in one unit, thus occupying a minimum amount of space, and requires little attention, is being manufactured by American Blower

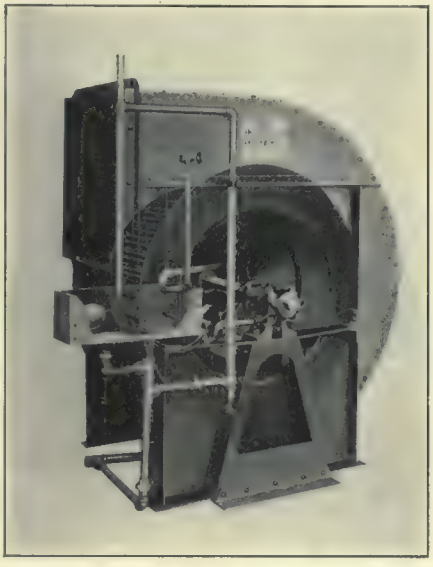


FIG. 1 AIR WASHER AND COOLER

Company, and is called the A-B-C Air Washing and Cooling Fan.

A multi-blade fan wheel revolving in a housing is provided with a large amount of screen filter surface which is kept wet by means of sprays. The water is prevented from passing through the wheels but is collected and used over again. An arrangement to furnish a constant overflow of water, regulated to suit individual requirements, removes the dust and dirt taken from the air and makes the device practically self-cleaning. The air passing over the wet surfaces absorbs water, thus both cooling and humidifying it while it is being washed and cleansed of dust and other impurities. There are no pumps, or pump motors, strainers or tanks to increase difficulty of operation or maintenance.

New Model Auto-Teller

THE National Automatic Teller Corporation has designed a new model of their Auto-Teller which has several advantages over that first marketed. The chief point of difference is that the new model has only one deposit slot, and receives and receipts for eight different amounts instead of four as in the original model. These amounts are either 25c, 50c, 75c, $1, $2, $5, $10, and $20; or, 5c, 10c, 15c, 25c, 50c, 75c, $1 and $5. The first set of figures is used in regular industrial savings plans and in the collection of Christmas Club dues. The latter set is used in school savings plans, where the smaller denominations are needed.

Accompanying this change in product, they also announce a change in selling policy. Auto-Tellers are now leased on a royalty agreement, under which the bank pays strictly in proportion to deposits. The original plan of flat rental fee is still offered, as well as a combination of it and the royalty plan.

Valve Movement Indicator

A DEVICE by means of which boiler-room attendants can keep an accurate check on the movement of the valve controlling boiler feed-water flow, to obtain maximum operating efficiency, has been developed recently. It is called the Copes Valve Movement Indicator and can be used in connection with practically any type of feed-water regulator.

FIG. 1 VALVE MOVEMENT INDICATOR

A wire fastened to the lever arm of the valve leads to the indicator dial. It runs on ball bearing pulleys so that the indicator responds to every movement of the lever. Whereas the control valve

must often be placed in inaccessible places, the indicating dial can be placed anywhere in the boiler-room. It is manufactured by Northern Equipment Company.

Ball Bearings

AMRON Ball Bearings are open-type annular bearings consisting of 3 parts—outer race, inner race, and cage with balls. These parts can be assembled or disassembled easily without the use of tools, and can be cleaned and lubricated without disturbing the mounting of the outer race in its housing or the inner race on the shaft. These bearings are of German manufacture and are being marketed by the Astra Specialties Company.

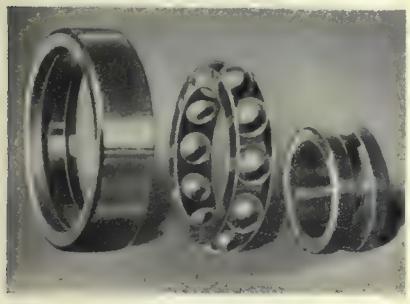


FIG. 1 OPEN TYPE ANNULAR BEARINGS

"Apex" CO_2 Recorder

A CO_2 recorder designed for small plants, and which, it is estimated, will cause enough fuel savings to justify its use on boilers as small as 50 hp., has been developed by Uehling Instrument Company. Inasmuch as the price of the new recorder is less than half that of the standard Uehling, it is believed that the new instrument will open up an entirely new field among the smaller plants.

The "Apex" CO_2 recorder employs no chemical solutions, and there are no moving parts except the pen mechanism. The "Pyro-Porus" filter and the standard Uehling gas dryer and desulphurizer are used, insuring permanent cleanliness of the gas line and interior parts of the instrument. As a result of these features the manufacturer claims that the recorder will operate accurately without any attention or adjustment other than the changing of charts and renewals of dry absorbent. Absorption of CO_2 in a dry cartridge causes a reduction in pneumatic pressure which, in turn, actuates the recording or indicating mechanism.

A corresponding instrument of the indicating type is also being manufactured. The indicator is a manometer containing a glass tube filled with liquid.

Quick Action Valve

JENKINS BROTHERS are making a valve for water pipes that can be opened by a quarter pull of the lever, stays open automatically, and can be closed by slight pull of the lever without producing water-hammer.

The hand lever bears on the end of the spindle, which pushes the disc off the seat to open the valve. Alignment of the lever with the spindle holds the valve open. A slight pull on the lever throws it out of alignment with the spindle and the disc is forced on the seat. Through a combination of spring, piston, and water pressure, the movement of the disc is regulated to avoid water-hammer.

Light Bulb Lock

A DEVICE to protect electric light bulbs against theft has been developed by Ren Manufacturing Company. When the bulb is locked in place by this method, it can be removed only by breaking the glass, for which a bag is provided to catch the broken glass. The lock consists of a groved ring and a coiled spring with a projecting end that prevents unscrewing the bulb. A special punch is used to attach the lock to the socket and it can be used with any standard socket.

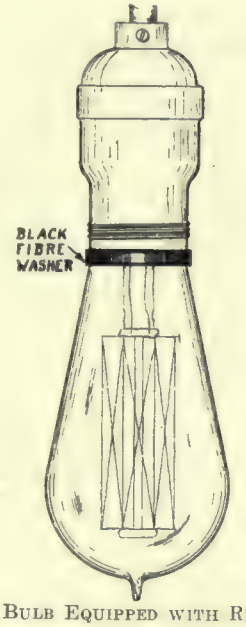


FIG. 1 BULB EQUIPPED WITH REN LOCK

FIG. 2 SPRING AND WASHER COMPRISING REN LOCK

Welding Unit

FOR the purpose of simplifying the welding process in production work where similar welds are made repeatedly on similar articles, a travel carriage has been developed for the automatic arc welding of straight seams. This carriage is a self-contained unit made by the General Electric Company. It consists of an automatic welding head, necessary control, travel motor and wire reel support, all mounted on a suitable framework and provided with wheels for rolling along a track.

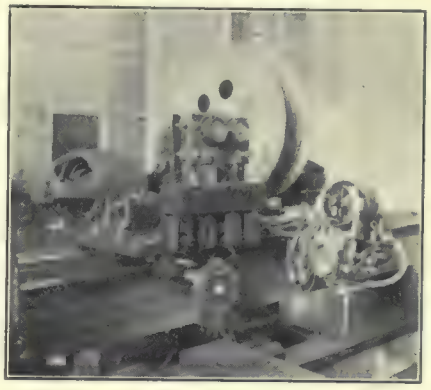


FIG. 1 WELDING UNIT

Control of the welding head and travel motor is so interlocked that, when the starting button is pushed, the arc is automatically established simultaneously with the starting of the travel motor. Should the arc fail for any reason, the travel motor will stop without overtravel and the arc will re-establish itself and the travel motor will re-start, all without attention from the operator, thus insuring a continuously welded seam. An adjustable time limit switch stops the motor at the end of the weld and the carriage is returned to the starting position either by hand, or electrically by manipulating the push buttons. The carriage can be provided with an oscillator to be used when welding heavy plate.

Equipment Catalogs

A MAINTENANCE map has been published by The Truscon Laboratories for determining which Truscon paint products are most suitable for various applications. The map consists of a cross-sectional view of a factory, on which each object is numbered in accordance with an index showing the proper product to use on it.

A 16-page booklet issued by the National Automatic Teller Corporation describes the uses and operation of Auto-Tellers.

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 150 magazines; it also includes the publications of some 50 book publishers and professional societies as far as these are of managerial interest to industrial executives. The items are prepared and classified by the Engineering Societies Library in New York City. The decimal number at the right of each item is the index number and indicates the place the article or book will take when filed in accordance therewith in the classified subject scheme. If articles are grouped according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. Photostat copies of any magazine article indexed can be supplied by The Ronald Press Company at a price of 25 cents the page. When ordering photostats please identify the article by quoting from the index: (1) Title of article; (2) Index number; (3) Name, date, volume number, and page number of periodical in which the item appears. A remittance of 25 cents a page should accompany the order. The books and pamphlets indexed can be procured from The Ronald Press Company or from their respective publishers.

Accounting

Accounting. 657.4
W. A. Paton. The Macmillan Company, New York. 894 pp. $3.50. A discussion of principles underlying accounting practice. Although the contents are rudimentary for an accountant, the treatment is comprehensive enough to provide business men with a sound knowledge of the accounting principles whose applications they continually meet in their work. Considerable attention has been paid to income determination, which is especially valuable to present-day business men confronted with the problem of income tax payment.

Application of Capitalization Tables. 657.42
A. W. Crump. *American Appraisal News*, November 1924, v. 9, pp. 274-277. The diminishing balance method and the sinking fund method of "finding the present value," the amount necessary to amortize the capital investment.

Co-operation Between the Comptroller and the Engineer. 657.4
J. W. Swaren. National Association of Cost Accountants. *Official Publications*, November 15, 1924, v. 6, no. 6. 12 pp. Emphasizes the importance of "engineeringly intelligent cost systems," and the need for the engineer's help in building up cost sheets, property records, etc.

Cost Accounting in the Domestic Beet Sugar Industry. 657.452
F. L. Crawford. National Association of Cost Accountants. *Official Publications*, November 1, 1924, v. 6, no. 5. 11 pp. Factors which make up the cost of the beets themselves, and the factory costs.

Costing of Winding and Insulating Coils. Pt. 2. 657.452
F. C. Lawrence. *Cost Accountant*, October 1924, v. 4, pp. 156-168. Details of a system of process costing for materials and labor, in the various operations. Touches on the need for specifications and the treatment of overhead expenses.

Departmental Costs in the Foundry. 657.452
H. B. May. *Foundry Trade Journal*, October 16, 1924, v. 30, pp. 333-335.

Determining Profits in Advance—Working Plans for Profit—3. 657.4
G. Charter Harrison. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 605-610. Charts. The work of the accountant in engineering firms, especially in regard to the opportunity to determine budgets and probable profits and costs.

The Fundamentals of Engineering Costs. 657.452
Andrew Stewart. *World Power*, November 1924, v. 2, pp. 261-266. Charts. States the purpose of cost accounts and defines costing terms and their relation to each other. Analyzes the elements of cost as material, labor, etc.

How a Cost System Was Started. 657.452
R. Graves. *Paper*, November 6, 1924, v. 35, pp. 93-95. Value of a cost system in paper mills.

How We Keep Costs at Their Proper Level. 657.452
E. F. Roberts. *Factory*, November 1924, v. 33, pp. 650-653. Charts. Describes the Packard cost control system which furnishes production costs up to the minute.

Power Plant Depreciation Factors. 657.42
MANAGEMENT AND ADMINISTRATION, December 1924, v. 8, p. 631. Discusses the chief factors entering into and causing depreciation in value.

Reconciliation of Cost Accounts. 657.452
R. J. H. Ryall. *Business Organization*, November 1924, v. 11, pp. 94-98. Methods by which the closest control may be exercised over the expenditure of a business, whether for labor, materials, or other items, and which automatically provide the means of reconciling this expenditure with the financial accounts.

Relation of Drop Forge Costs to Percentages of Operation. 657.452
R. T. Herdegen. *Forging-Stamping-Heat Treating*, November 1924, v. 10, pp. 405-409. A comprehensive analysis of the problem, with data compiled from various forge shops.

Advertising

The Circular Advertising Department. 659.13
W. W. Beardsley. The Ronald Press Company, New York. 116 pp. $1.25. An ever-increasing amount of merchandising is being done by mail, especially the stimulation of desire by advertising campaigns. The organization and operation of the circularization department is an important item in success of any direct-by-mail campaign. In this book is presented authoritative information on both the organization and the detailed operation of such a department. It will be valuable to all business men who use this method of merchandising.

Getting All Distributors to Concentrate in an Advertising Drive. 659.1
J. A. Murphy. *Printers' Ink Monthly*, November 1924, v. 9, pp. 19-20, 152. Illus. The success of the "week" drive as a selling practice depends upon sufficient advertising during the week, co-operation from the retail trade, and continued advertising during the remainder of the year.

Getting the Dealer to Show His Colors. 659.1
Ralph Crothers. *Printers' Ink Monthly*, November 1924, v. 9, pp. 43-44, 116. Illus. The selling value of distinguishing signs and posters to identify products and places where they are sold.

Building

Concrete Buildings for Industrial Plants. 658.2
J. F. Springer. *Gas Age Record*, November 1, 1924, v. 54, pp. 639-641. Describes use in gas-works, sky-light construction, building with crane girders, etc.

The Factor of Plant Location in Automobile Production. 658.112
J. A. Piquet. *Industrial Management*, November 1924, v. 68, pp. 297-304. Illus. Policies of some of the leading automotive concerns as to location. Shows the growing tendency to decentralization and distribution of units throughout the country, to meet market growth and changing conditions.

Let Concrete Bring Economy. 693.5
A. S. Rosing. *Steam Power*, November 1924, v. 3, pp. 5, 10. Illus. Constructing power plants by means of concrete with increased efficiency and lowered costs as a result of its fire-resistive quality, its rigidity, strength, long life, etc.

Maintenance: Gearing Up Both Plant and Equipment for Low-Cost Production. 3—Plant Design, Construction, and Alteration. 658.2
K. D. Hamilton. *Factory,* November 1924, v. 33, pp. 645-649, 716. Illus. Factors that must be considered when a new plant is to be built. Considers site, style and layout of building; the architect and the plant engineer, etc.

Modern Electric Lighting in Factories. 658.242
C. W. Sully. *Business Organization,* November 1924, v. 11, pp. 99-102. Illus.

Planning the Construction Program. 658.2
A. G. Anderson. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 595-598. The value of specialized knowledge in solving building problems. The industrial building must be designed for *what* is to be done and *how* it is to be accomplished, and firms having specialized in industrial layout work should be called to design and construct.

Processes Affect Design of Automobile Factories. 658.2
F. A. Fairbrother. *Engineering-News Record,* November 20, 1924, v. 93, pp. 834-836. Illus. Comparisons between the multi-story and the single-story building. Points out the advantages and disadvantages as to lighting, ventilating, handling of materials, etc.

Savings Produced by Power Equipment. 658.16
George E. Hagemann. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 627-630. Experience data from typical industrial plants.

Sixty-eight Per Cent More Light from the Same Equipment. 658.24
D. W. Atwater. *Factory,* November 1924, v. 33, pp. 665-666, 704. Illus. Painting walls and ceilings, and washing lamps and reflectors resulted in this increased illumination.

Study of Foundry Building Design. 658.2
Iron Age, November 20, 1924, v. 114, pp. 1334-1337. Diagrs. The influence of site selection, building layout, material storage, and methods of operation on better foundry practice. Compares several existing plants with these essentials in view.

Economics

Commerce Year Book—1923. 38(73)
Department of Commerce, Washington, D. C. 722 pp. 85 cents. The second annual issue of this year book presents a concise picture of the world's industry and commerce for 1923 with special reference to the United States. It contains practically everything of recordable interest about the business life of the nation and of its foreign competitors and customers. Being the result of the combined efforts of a large staff of business observers and trade experts in all parts of the world, the book provides an authentic reference book of basic facts, and a guide to the study of outstanding problems of trade, production, price changes, and market conditions. A book that should be owned by every American business man.

Forecasting the Underlying Cycles—Industrial Budget Methods—3. 338.97
Joseph H. Barber. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 589-594. Charts. Economic cycles and conditions under which subsidiary cycles average so as to show a cycle movement. An imaginary case is taken and the probable cycles explained. Graphic and statistical charts are included.

How America Organizes Trade Promotion. 382
F. W. Carter. *Business Organization,* November 1924, v. 11, pp. 121-122, 125-126. Work done by the United States Board of Trade to co-operate with the manufacturer in trade promotion. Lists department publications and describes the work of consular officers and trade commissions.

Income Taxes—Pure and Simple. 336.24
M. L. Seideman. *Black Diamond,* November 15, 1924, v. 73, pp. 556-557. Interpretation of 1924 Revenue Act.

Planning for Industrial Mobilization. 355.21
J. W. Weeks. *Trade Winds,* November 1924, pp. 1-4, 22.

Usury and Usury Laws. 332.8
Franklin W. Ryan. Houghton Mifflin Company, New York. 249 pp. $2.50. The author divides usury into two classes: legal usury, or taking more than the law allows, and moral usury, or taking advantage of the borrower's ignorance or necessity to take unduly high charges from him. After an exhaustive discussion of all influencing factors, the conclusion is reached that the present state usury laws should be repealed and new legislation, similar to the Uniform Small Loan Law, enacted, not to fix maximum interest rates, but to regulate charges in accordance with the cost of making the loan.

Financial Control

Costs for Executives. 4—Is Your Burden Equitably Distributed? 658.14
N. A. Hall. *Industrial Management,* November 1924, v. 68, pp. 283-286. Methods of distributing the costs of the non-productive to the productive departments, to determine factory and selling costs of the product.

Determining Profits in Advance—Working Plans for Profit—3. 658.14
G. Charter Harrison. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 605-610. Charts. The work of the accountant in engineering firms, especially in regard to the opportunity to determine budgets and probable profits and costs.

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Importance of Production Department in Budgetary Control. 658.14
F. J. Knoeppel. *Management,* November 1924, v. 23, pp. 48-49. Functions of the manufacturing branch in fixing the factory budget and its responsibility in helping to meet expectations.

Fuel

Auxiliary Equipment for Oil Burning. 662.75
Kester Miller. *Fuels and Furnaces,* November 1924, v. 2, pp. 1149-1154. Part 2 is devoted to turbo-blowers.

British Progressive Coal Research. 662.65
A. C. Blackall. *Black Diamond,* November 22, 1924, v. 73, pp. 579-580. Fuel Research Board on year's activities. Survey of nation's resources and suggestions for fuel economy.

Coal Versus Fuel Oil for Industrial Use. 662.6
F. W. Harris. *Steam Coal Buyer,* November 1924, v. 2, pp. 26, 28.

Combustion Devices for Gaseous Fuels. 662.76
W. Trinks. *Fuels and Furnaces,* November 1924, v. 2, pp. 1157-1160. Discusses devices which mix gas and air in the furnace, and burners which induce air from the atmosphere with varying degrees of premixing.

Hazards of Industrial Oil Burning. 662.75
H. E. Newell. *Mechanical Engineering,* Mid-November 1924, v. 46, pp. 765-768. Discussion of flash point, heating oils in storage tanks, oil storage methods, oil-burning systems, and their installation and operation, with a view to decreasing fire hazards.

Hazards of Pulverized Fuel Systems. 662.65
H. E. Newell and R. Palm. *Mechanical Engineering,* Mid-November 1924, v. 46, pp. 783-784. Features underlying proper installations, types of systems, safety requirements.

Industrial Coal; Purchase, Delivery, and Storage. 662.65
Report of American Engineering Council. The Ronald Press Company, New York. 419 pp. $5. The American Engineering Council, in collaboration with the President's Coal Commission, other governmental agencies and several hundred engineers, undertook the task of finding a solution to the industrial coal problem. The solution discovered was seasonal storage of coal, and this book presents the basis for this conclusion, together with the various measures necessary to carry the plan into effect, and its influence on existing conditions. Among the subjects discussed by eminent engineers are: deterioration and spontaneous combustion; storage problems,

including location, equipment, and cost; insuring, taxing, and financing coal in storage, and a survey of storage needs of 41 principal towns throughout the entire United States. This is a valuable book and should be read and studied by every business man who is at all affected by the supply and demand for coal.

Practical Methods in Fuel Economy. 662.6
Robert Collett. *Steam Coal Buyer*, November 1924, v. 2, pp. 21-22, 24. With special reference to railroad operation.

Spontaneous Combustion. 662.65
Colliery Guardian, October 17, 1924, v. 128, p. 1000.

Standardization of Colliery Requisites. 662.65
Colliery Guardian, October 17, 1924, v. 128, p. 1014.

The Storage and Handling of Fuel Oil in Industrial Plants. 662.75
C. G. Sheffield. *Mechanical Engineering*, Mid-November 1924, v. 46, pp. 771-773. Considers briefly location, foundations, construction of the tanks themselves, heating, and unloading.

Will There Be an Adequate Supply of Fuel Oil at Reasonable Prices Tomorrow? 662.75
Universal Engineer, November 1924, v. 40, pp. 27-28. No shortage or prohibitive prices anticipated.

Industrial Methods

Chemistry in Industry. 66
Edited by H. E. Howe. The Chemical Foundation, New York. 372 pp. $1. To anyone who has given little thought to the subject, the importance of chemistry to industry as related in this book is surprising. It consists of articles written by 21 specialists, representing as many different industries, in which are described the accomplishments of chemistry in their fields of work. The book is very interesting and, in some of the unsolved problems presented, unusual opportunities are indicated for future developments. Only a few of the many industries are treated here but the publishers hope to present a second volume later in which more industries can be covered.

Curtailing Manufacturing Costs. 676
Paper, November 20, 1924, v. 35, pp. 174-176. Detailed description of German method of manufacturing paper economically.

Die Casting. 621.98
N. C. Barnard. *Mechanical Engineering*, November 1924, v. 46, pp. 661-669. Illus. Diagrs. Considers the different types of die-casting machines, the representative alloys used in castings, and the problems of die construction, inserts, etc.

How Electric Heat Has Been Put to Work in Low Temperature Enameling. 666.26
W. B. Scott. *Automotive Industries*, November 20, 1924, v. 51, pp. 892-896. Illus. Tests and experiments which led to the successful heating of the enameling baking ovens by electricity.

How to Avoid Injuring Wire Rope by Careless Handling. 677.72
Steam Power, November 1924, v. 3, pp. 8, 10. Illus.

The Manufacture of Plate Glass for Automobile Uses. 666.1
J. H. Fox. *Society of Automotive Engineers Journal*, November 1924, v. 15, pp. 449-455. Discusses the various processes involved in the manufacture of polished plate glass, imperfections, strength, salvage of waste glass.

Production Airplanes of Metal. 629.13
E. B. Carns. *Mechanical Engineering*, Mid-November, 1924, v. 46, pp. 733-738. Detailed description of a method of construction of metal biplanes, which, through economical production, solves the problem of commercial aviation.

The Railways and Wood Preservation. 691.15
R. H. Aishton. *Railway Review*, November 22, 1924, v. 75, pp. 834-837. On timber purchasing and the railroads' contribution to wood preservation.

Report on Placing Concrete in Winter. 693.5
Railway Review, October 25, 1924, v. 75, pp. 625-629. Feasibility, economy and desirability of winter concrete work and detailed information on approved methods.

Iron and Steel

The Development of Electro-Steel Manufacture in Germany. 669.187
Franz Sommer. *Engineering Progress*, November 1924, v. 5, pp. 244-246. A consideration of the electric arc furnaces, the induction furnaces, and the electro-steel smelting process, comparing the latter with other steel processes.

Electric Welding and Arc Welding of Ingot Iron. 621.392
(Uber elektrische Schweissung und Lichtbogenschweissung von Flusseisen.) H. Neese. *Zeitschrift des Vereines Deutscher Ingenieure*, October 25, 1924, v. 68, pp. 1125-1132.

The Indian Steel Industry (Protection) Act and Its Probable Effects on British Steel Exports. 669.1
Iron and Coal Trades Review, November 14, 1924, v. 109, pp. 792-794.

Iron Output and Price Related. 669.1
L. P. Ayres. *Iron Trade Review*, November 6, 1924, v. 75, pp. 1232-1233. Charts. The blast furnace index, showing the changes in output and price of pig iron for a period of 27 years, indicates that the recovery in price lags behind the recovery in output.

Using Electric Heating Furnaces. 669.1
A. E. White. *Iron Trade Review*, November 6, 1924, v. 75, pp. 1229-1231. Electric heating furnaces of box-type, reverse-flow, annular-ring or doughnut-type construction for annealing, quenching and drawing. Includes a list of essentials of furnace design.

Maintenance

Organizing for Plant Maintenance Work. 658.58
L. A. Blackburn. *Society of Automotive Engineers Journal*, November 1924, v. 15, pp. 440-444, 448. Functions of the various departments under the direction of the maintenance engineer—plant policing, protection against fire, operation of the power plant, machine repair, inspection, etc.

Possible Economies in Automotive Machine Shop Operations. 658.58
A. L. DeLeeuw. *Society of Automotive Engineers Journal*, November 1924, v. 15, pp. 418-425. Emphasizes the importance of careful selection and maintenance of tools, and discusses various auxiliaries, as automatic stock-feeding devices, chucking devices, etc.

Repair and Maintenance of Pneumatic Tools. 658.582
E. A. Hildebrandt. *Railway Mechanical Engineer*, November 1924, v. 98, pp. 689-690.

Repairing and Rebuilding Electric Elevators. 658.58
R. H. Kuehmsted. *Industrial Engineer*, November 1924, v. 82, pp. 512-518, 553. Illus. The order systems and shop routine used by Thompson and Jameson, Inc.

Tool Salvage. 658.582
L. A. Churgay. *Society of Automotive Engineers Journal*, November 1924, v. 15, pp. 456-460. How the salvage department can keep in touch with current needs, the use of standard forms of purchase and interdepartment requisitions, details of tool reclamation.

Tracing Knocks in Engines While Rotating. 658.581
Eric Prince. *Mechanical World*, November 7, 1924, v. 76, pp. 296-297. The use of the microphones, stethoscopes and oil; and the senses of sight and feeling in repair work.

Union Pacific Systematizes Running Repairs. 621.138
Railway Mechanical Engineer, November 1924, v. 98, pp. 694-696. Illus. The installation of a system of monthly locomotive inspection and repairs.

Management

Business Organization from a New Viewpoint. 658
E. P. Hyde. *Industrial Management*, November 1924, v. 68, pp. 273-280. Suggestions for setting up and gaging the value of a General Division whose functions would embrace administration and auxiliary activities such as manufacturing development (reduction of costs, improvement of product, research) sales development, etc.

Scientific Management Since Taylor. 658
Edited by Edward Eyre Hunt. McGraw-Hill Book Company, New York. 263 pp. $3. A collection of papers and addresses by well-known engineers and industrialists which gives a rather disconnected story of the progress made by Scientific Management during recent years. No new material is contained in the book, but it does present authoritative information on a number of phases of Scientific Management. It should prove valuable as a general reference book for business men interested in learning what has been accomplished by modern management methods.

Shop Management. 658
Frederick W. Taylor. *Mechanical Engineering*, Mid-November 1924, v. 46, pp. 806-807. Excerpts from a paper presented at the meeting of the American Society of Mechanical Engineers, June 1903. Touches on wages, planning, time study, personnel relations, etc.

Management of Special Industries

The Development of a Modern Hosiery Plant. 658.9:687.3
S. E. Thompson and H. T. Rollins. *Mechanical Engineering*, Mid-November 1924, v. 46, pp. 752-764. Detailed discussion of developments in organization, personnel work, production control, standardization, cost control, and marketing, in the Rollins Hosiery Mills, Iowa.

The Engineer's Field in Industrial Economics. 658.9:677
Eugene Szepesi. *Mechanical Engineering*, Mid-November 1924, v. 46, pp. 841-848. Practical application of scientific principles to the solution of problems of material control, production control, and wage determination, in the textile industry.

The Factor of Plant Location in Automobile Production. 658.9:629.113
J. A. Piquet. *Industrial Management*, November 1924, v. 68, pp. 297-304. Illus. Policies of some of the leading automotive concerns as to location. Shows the growing tendency to decentralization and distribution of units throughout the country, to meet market growth and changing conditions.

Identification of Material Handling Costs Develops Unusual Possibilities. 658.9:656.2
Railway Review, November 8, 1924, v. 75, pp. 706-714. Illus. System established in the Angus shops of the Canadian Pacific Railway, permits correct cost-finding and control of production costs.

Possible Economies in Automotive Machine-Shop Operations. 658.9:621.9
A. L. De Leeuw. *American Machinist*, November 6, 1924, v. 61, pp. 735-738. Discusses operation methods, condition of cutting tools and cost of non-productiveness.

Relation of Drop Forge Costs to Percentages of Operation. 658.9:621.73
R. T. Herdegen. *Forging-Stamping-Heat Treating*, November 1924, v. 10, pp. 405-409. A comprehensive analysis of the problem, with data compiled from various forge shops.

A System of Foundry Organization and Cost Recording. 658.9:621.72
M. Nicholls. *Foundry Trade Journal*, October 16, 1924, v. 30, pp. 324-325. Illustrated with record forms.

Time Studies in the Forge Shop. 658.9:621.73
(Arbeitszeitbestimmung in der Mittleren Freiformschmiede.) Max Zscheile. *Werkstattstechnik*, November 1, 1924, v. 18, pp. 597-614. Illus. Describes with detail how the studies were made, results arrived at, and gives graphic charts of various operation studies.

Why Cost Figures Changed Our 165-Year Old Policies. 658.9:667.6
E. S. Phillips. *Factory*, November 1924, v. 33, pp. 639-641. Modern management methods introduced by paint company increased production and stabilized manufacture and sales the year round. Outlines cost system installed and information it was required to furnish.

Material Control

Control of Stock in Warehouse. 658.78
D. G. MacInnes. *Iron Age*, November 27, 1924, v. 114, pp. 1401-1403. Suggests various methods that may be employed, including aids in buying and follow-up systems.

Eleven Packing Problems and How They Were Solved. 658.78844
H. N. Knowlton. *Factory*, November 1924, v. 33, pp. 662-664, 708. Illus. New methods of crating polished cabinets, telephone apparatus, washing machines and gas stoves, etc.

The Problem of Delivery Equipment. 658.7885
Wilfred Eldred. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 599-604. Service for bakers, involving wholesale and retail delivery. The efficiency of horse-drawn, gasoline and electric vehicles is considered with the conclusion that the highest grade and best maintained equipment usually go together.

The Storage and Handling of Fuel Oil in Industrial Plants. 658.78:665
C. G. Sheffield. *Mechanical Engineering*, Mid-November 1924, v. 46, pp. 771-773. Considers briefly location, foundations, construction of the tanks themselves, heating, and unloading.

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Equipment and Maintenance in the Plant Yard. 658.281
W. G. Ziegler and M. W. Potts. *Industrial Management*, November 1924, v. 68, pp. 287-293. Illus. Various types of outdoor material-handling machinery. Emphasizes the importance of maintenance.

Low-Cost Handling of Coal and Ashes. 658.281:662.65
Fritz Schultz. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 623-626. Illus. A system suited to industrial power plants.

Making 15 Men Equal to 30. 658.281
H. D. Cromwell. *Management*, November 1924, v. 23, pp. 62-64. Lift trucks and platforms double efficiency of furniture handlers.

Material Handling in a Plant Making a Diversified Product. 658.281
H. C. Perkins. *Factory*, November 1924, v. 33, pp. 654-657. Illus. Large capacity cranes, conveyors, electric trucks, trailers and hand trucks, and how they are used at the Bloomfield works of the General Electric Company.

Operation and Selection of Small Hoists. 658.281
R. B. Hunter. *Industrial Engineer*, November 1924, v. 82, pp. 527-530, 554. Illus. Considers the electric hoists in one-half ton to two ton capacities.

Up-to-Date Jig-back Ropeways. 658.2812
G. F. Zimmer. *Cassier's Industrial Management*, November 1924, v. 11, pp. 475-478. Illus., diagrs. Bucket conveyors with tipping devices entirely under the control of the operator.

Mineral Industries

Concrete in and Around Coal Mines. 693.5
Black Diamond, November 8, 1924, v. 73, pp. 528-529. Illus.

Food Requirements of Coal Miners. 658.383
K. N. Moss. *Iron & Coal Trades Review*, October 3, 1924, v. 109, p. 556. Discussion of the calorie value of food in relation to work output.

The Inhalation of Dust. 613.63
H. M. Carleton. *Colliery Guardian*, October 31, 1924, v. 128, p. 1127. Report to Medical Research Council covers tests with various dust, coal, china clay, felspar, silica, etc.

Standardization of Mining Equipment. 622
Colliery Guardian, November 14, 1924, v. 128, p. 1252.

The Valuation of Mines and Minerals and the Relation of Income Tax to Such Valuations. 622:657.42
Colliery Guardian, October 10, 1924, v. 128, p. 940.

Office and Equipment

Annotated Forms of Agreement. 651.72
Saul Gordon. Prentice-Hall Inc., New York. 919 pp. $10. A great deal of litigation arises from improperly written contracts or agreements. The addition or absence of a single word may so alter the context of the agreement that judicial

action becomes necessary to decide just what has been agreed to by its makers. This book contains over 400 forms of agreement that can be used as examples in preparing similar contracts. A large part of them have been involved in litigation and their meaning judicially determined. Others have been prepared and scrutinized by experienced attorneys as to their relation to laws applicable to them. Practically every kind of written agreement is represented and every business man will be able to use some of them in drawing up forms covering his own activities.

Cash Records. 651.5
George T. Hallman. The Ronald Press Company, New York. 117 pp. $1.25. A manual covering effective methods of controlling cash received and disbursed in all sorts of business transactions by many types of business enterprises. Proper control consists principally of a number of small but important details which must be watched closely. Mr. Hallman has given much information about these details and how they may best be utilized in controlling cash.

Locating an Office. 651
Warren D. Bruner. *Bulletin of the Taylor Society*, October 1924, v. 9, pp. 225-229. Analysis of the factors that must be considered, as: in what city or town, in what site or in what building, etc.

Use of Telephone in Business. 651.3
J. C. Seammell. The Ronald Press Company, New York. 113 pp. $1.25. Essential principles governing the proper use of the telephone in business. Since contacts made by telephone are valuable to any business, it is important that switchboard operators, secretaries, salesmen, clerks, and all others who have occasion to use the telephone, understand its use and how best to transact business by it. In this book essential information on this subject is presented in concise, clear, and interesting manner.

Personnel

Better Methods in the Drafting Room. 658.31243
J. Flodin. *Industrial Management*, November 1924, v. 68, pp. 293-296. The importance of the chief draftsman in establishing and maintaining the proper ideal of service, in providing suitable record systems, and in encouraging the men.

Co-operative Labor Plan, Baltimore & Ohio Railroad. 658.3151
Daniel Willard. *Railway Review*, November 8, 1924, v. 75, pp. 761-763.

Employee Representation Plans. 658.3151
Metropolitan Life Insurance Company, New York. 27 pp. A summary and brief analysis of employee representation plans recently developed in American industry. First is given a general survey of plans, their history, essential requirements, common methods of procedure, and general results attributable to them. Following this are summaries of plans now in operation in 11 well-known concerns, with a graphic analysis of their salient features. A bibliography completes a valuable publication for all who may wish to obtain, in condensed form, authoritative information about employee representation.

Industrial Unemployment Insurance. 331.2544
S. B. Ackerman. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 647-649.

Making Kodaks and Contentment. 658.3174
J. E. Webber. *American Industries*, November 1924, v. 25, pp. 27-30, 34. Illus. The Eastman Kodak Company; its history, organization, and policies, emphasizing particularly its stock-sharing arrangement for employees.

Management Is Life of Business. 658.3
C. B. Williams. *Iron Trade Review*, November 27, 1924, v. 75, pp. 1434-1437. Applies the Ten Commandments to business management and discusses the booklet recently prepared by the United States Chamber of Commerce, called "Principles of Business Conduct".

Medical Service and Safety in the Chemical Plant. 658.3822
B. J. Slater. *National Safety News*, December 1924, v. 10, pp. 21-22. Illus.

Organizing Personnel Work in a Textile Mill. 658.315
E. C. Gould. *Industrial Management*, November 1924, v. 68, pp. 280-282. Outlines the organization and duties of a Service Department composed of a general committee made up of mill executives, and subcommittees for questions of employment, education, safety, etc. Shows improved conditions as a result of policies recommended and adopted.

Power Plant Personnel. 658.3
K. W. Stillman. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 633-636. Charts. Selection, training and promotion of steam power station employees.

Practical Points on Labor Policy. 658.3
B. A. Franklin. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 611-614. Describes relations that should exist between employer and employee and the public they mutually serve and suggests methods for bringing about this necessary harmony.

Proficiency Tests for Stenographers. 658.31156
Eugene J. Benge. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 615-616.

Recording the Worker's Personality. 658.31255
D. A. Laird. *Industrial Management*, November 1924, v. 68, pp. 307-314. Charts. Discusses methods of rating employees' personal traits and gives points to be observed which work for more accuracy.

Power and Power Plants

Development of Gas and Oil Turbines. 621.311
Iron Age, November 27, 1924, v. 114, pp. 1407-1410. Diagrs. Test data showing the efficiency obtained and cost and efficiency calculations made in different types of power plants.

Electric Steam Generators. 621.1816
L. G. de Kermor. *Engineering Journal*, November 1924, v. 7, pp. 673-677. Diagrs. The development, efficiency and operation of the electric steam generators of the water resistance type. How they solve the problem of the utilization of surplus and off-peak energy.

The Executive and His Power Department. 5-6. 658.26
Miles Sampson. *Textile World*, v. 66, October 4, 1924, pp. 81, 83-84, November 1, 1924, pp. 65-71. 5,—Steam-driven prime movers, advantages of the turbine and alternating current generator, low pressure steam, true thermal efficiency, etc. 6,—Considers the future of the mill power department, emphasizing, among other things, the advantages of power plant consolidation and central power stations.

Factors in Industrial Plant Location. 658.21
P. F. Walker. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 637-642. Economic factors that must be considered for power plant location and the influence on the profitable operation of the enterprise.

Fundamentals Concerning German Electric Power Production. 621.31003
(Grundsätzliches zur deutschen Elektrizitätswirtschaft.) G. Klingenberg. *Zeitschrift des Vereines Deutscher Ingenieure*, November 8, 1924, v. 68, pp. 1168-1170.

Management in Power Plant Building. 658.26
Frank S. Clark. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 585-588. Illus. Describes equipment of the Pittsburgh Plate Glass Company power house at Kokomo.

Present and Future Power Equipment. 658.26
Hubert E. Collins. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 617-622. Survey of power sources. Central stations and private-owned plants both have an open field for science. Prime movers are discussed and the hydroelectric "super power" situation analyzed.

Significance of the World Power Conference. 62(063)
H. N. Casson. *Industrial Management*, November 1924, v. 68, pp. 255-259. Points of interest in papers delivered at the conference. Shows the growing use of water power and electricity as compared with coal, in the various countries, and the superiority of private enterprise over state control.

Some Features of Motor Applications in Industrial Plants. 658.26
E. Douglas. *Industrial Management*, No-

vember 1924, v. 68, pp. 314-316. Brief notes on electric drive, individual and group drive, load, etc.

Some Practical Pointers on How Variable Speeds Can Be Obtained. 658.262
F. E. Gooding. *Industrial Engineer*, November 1924, v. 82, pp. 519-524, 555. Illus. Variable speed transmission devices and units suggested for use on textile machines, paper mills, wire and rope machines, biscuit machines, etc.

Ventilating Electrical Machinery. 621.313
Iron Trade Review, November 27, 1924, v. 75, pp. 1443-1446. Illus. Transition from steam to electric drive in the steel industry and the part taken by air conditioning apparatus.

Water-Cooling-System Efficiency. 621.175
V. J. Azbe. *Mechanical Engineering*, Mid-November 1924, v. 46, pp. 799-805. Formulas and charts for use of power-plant and refrigerating-plant engineers, in predetermining performance of water-cooling systems at different seasons: cooling possibilities under different weather conditions.

Water Treatment for Continuous Steam Production. 621.1871
R. E. Hall. *Mechanical Engineering*, Mid-November 1924, v. 46, pp. 810-817. An investigation of water treatment in its relation to prevention of scale formation, corrosion control, delivery of dry steam, and maintenance of minimum of blow-down.

Production Control

The Advertising Barometer. 658.53
Harold Herd. *Business Organization*, November 1924, v. 11, pp. 133-138. Describes the kind of charts that would help the executive to foretell business conditions.

Card Record System for Tool Department. 658.563
W. H. Kellogg. *Machinery*, November 1924, v. 31, p. 211. Illus. A system whereby each tool is listed on cards and indexed according to tool number.

Checking Lathes for Accuracy. 658.562
Machinery, November 1924, v. 31, pp. 195-199. Illus. Describes in detail the methods used by the American Tool Works Co. to inspect the various parts of the lathes and the assembled machines.

The Engineer's Field in Industrial Economics. 658.5
Eugene Szepesi. *Mechanical Engineering*, Mid-November 1924, v. 46, pp. 841-848. Practical application of scientific principles to the solution of problems of material control, production control, and wage determination, in the textile industry.

Enter Order—When Will You Ship? 658.5
H. S. Riggs. MANAGEMENT AND ADMINISTRATION. December 1924, v. 8, pp. 643-645. Illus. Methods of controlling production. Forms of cards and tags illustrate the job routing and accumulative cost data.

Fatigue a Vital Consideration of Forge Shop Management. 658.544
Joseph Thompson. *Forging-Stamping-Heat Treating*, November 1924, v. 10, pp. 409-412. Nervous and mental fatigue the real problem in the shop and the cause of much industrial unrest.

The Function of Tool Salvage. 658.5
L. A. Churgay. *Michigan Manufacturer and Financial Record*, November 15, 1924, v. 34, p. 8. Reclamation and adaptation of equipment, an important factor in industry.

No Safe Short Cut to High Production. 658.5
H. H. Farquhar. *American Machinist*, November 6, 1924, v. 61, pp. 727-729. Emphasizes the management's part in effecting increased production. Incentive payment schemes useless without proper operation preparations.

Reducing Shop Cost in the Engineering Department. 658.5
J. A. Davis. *American Machinist*, November 13, 1924, v. 61, pp. 761-764. Reducing quantity and variety of tools and fixtures and avoiding close tolerances where they are unnecessary.

Returned Goods in the Jobbing Plant. 658.5
E. W. Leach and J. F. Koch. *American Machinist*, November 13, 1924, v. 61, pp. 757-758. Procedure and forms necessary for the disposition of returned pieces.

Signals in the Shop to Speed Production. 658.56
C. J. Priebe. *American Machinist*, November 6, 1924, v. 61, pp. 731-734. Illus. How the workman calls the foreman, inspector or dispatcher according as each is needed to keep materials moving.

Simplicity of Organization: What it Means. 658.56
W. J. Hiscox. *Mechanical World*, November 21, 1924, v. 76, pp. 330-331. When the duties of each department, manager, and worker are scientifically planned, efficiency naturally follows.

Testing Materials in the Laboratory. 658.573
Machinery, November 1924, v. 31, pp. 184-186. Illus. How the quality of the materials used in building machines is controlled by means of tests and chemical analyses at the Bullard Machine Tool Company.

Safety

Around the Clock with Safety at Big Ben's Home. 658.283
C. T. Fish. *National Safety News*, December 1924, v. 10, pp. 11-14. Illus. Methods used by the Western Clock Company prevents accidents at its plant.

Identifying Pipe Lines and Valves. 658.283
David Fliegelman. *Industrial Engineer*, November 1924, v. 82, pp. 525-526. Illus. The use of color schemes for pipes and valves to avoid errors in identification.

Knocking Out Home Runs in the Fairies' Safety League. 658.283
G. E. Wallis. *National Safety News*, December 1924, v. 10, pp. 5-9. Illus. Team work among the employees of Fairbanks, Morse and Company has made possible the installation and application of the latest safety devices for foundries.

Practical Uses of the Logging and Sawmill Safety Code. 658.283
J. A. Dickinson. *National Safety News*, December 1924, v. 10, pp. 35-38. Illus.

Storage Tanks for Oils, Acids and Dry Materials. 658.283
National Safety News, November 1924, v. 10, pp. 41-48. Illus. Discusses the hazards of storage of liquids and dry materials not under pressure and suggests safety equipment in each case.

They're "Watching Safety Constantly" at Portsmouth Works. 658.3823
C. T. Fish. *National Safety News*, November 1924, v. 10, pp. 19-22. The constant installation of additional safety devices and the large reduction of accidents at the Wheeling Steel Corporation of 5000 employees are due to the combined work and co-operation of the superintendents, foremen and safety committee men at the works.

Selling and Buying

Developments in Scientific Methods for Selecting Salesmen. 658.81
H. C. Kenagy. *Sales Management*, November 1924, v. 7, pp. 1751-1754. The need for analyzing thoroughly the salesman's job and the qualifications essential for success. The use of tests and rating scales.

Digging Dollars Out of Raw Material Purchases. 658.7
Automotive Industries, November 6, 1924, v. 51, pp. 808-809. Points worth considering on what, where and when to buy.

How Phillips Jones Got Around the Hand-to-Mouth Epidemic. 658 81
Joseph Ewing. *Sales Management*, November 1924, v. 7, pp. 1705-1707, 1811. A system of field control of salesmen and their activities by means of quota sheets, work sheets, daily reports, and route control records.

How We Get Our Salesmen to Follow Our Policies. 658.807
M. S. Florsheim. *Printers' Ink Monthly*, November 1924, v. 9, pp. 41-42, 49. The Florsheim Shoe Company prepares its men for salesmanship and introduces them to its policies by first giving them from six to eight months' experience working in the factory plant, shipping, credit, advertising, and house trade departments.

The Link Between Office Managers and Salesmen. 658.81
T. R. Macklin. *Canadian Manufacturer*,

October 1924, v. 44, pp. 26-28. What and why salesmen should make reports to sales managers. Cites practices of two companies.

Management Difficulties in Small Factories and Their Solution: 3—Credit Rating. 658.882
H. W. Ross. *Cassier's Industrial Management*, November 1924, v. 11, pp. 467-468, 470.

The Qualifications of a Purchasing Agent. 658.71
Claude T. Yates. *Bulletin of the Taylor Society*, October 1924, v. 9, pp. 230-232. His functions and what he contributes in a scientifically managed plant.

Recording Sales Transactions. 658.817
G. T. Altman. The Ronald Press Company, New York. 92 pp. $1.25. Accepted methods for accounting by sales are concisely described with numerous illustrations of forms to be used. The book is divided into three parts: 1. Original records for cash, cash and credit, credit sales, and sales deductions. 2. Sales journals for cash, and cash and credit transactions, and for wholesale and manufacturing concerns. 3. General controls such as ledger accounts and sales reports.

A Sales Analysis That Saves $1,000 a Month. 658.81
F. E. Rand. *Sales Management*, November 1924, v. 7, pp. 1733-1744. Machine method of preparing complete analysis of sales by product, territories, and values, which can be used at once by the manager as a guide in regard to necessary advertising, personal letters, etc.

The Sales Manager Who Is America. 658.811
J. J. Witherspoon. *Printers' Ink Monthly*, November 1924, v. 9, pp. 33-34, 79. The sales manager who knows more than his salesmen, yet who permits his men to use initiative, is the "America" type of sales manager—the one who lets himself be discovered.

Taking the Guesswork Out of Business. 658.8
William R. Bassett. B. C. Forbes Publishing Company, New York. 179 pp. $2. In each of 12 chapters one subject relative to business management is discussed. These subjects include selling, purchasing, financing, production, advertising, and credit. A large part of the discussion consists of examples drawn from actual business experiences, showing how different business enterprises have solved their many problems. Chiefly because of this fact the book will be of considerable service to executives confronted with similar problems.

Why Not Discard the Double Standard in Buying and Selling? 658.7
Harry Tipper. *Automotive Industries*, November 13, 1924, v. 51, pp. 833-835. Integrity of contracts is the foundation of business, and ethical considerations are more important than laws.

Why Not Use the Standard Invoice Form? 658.773
R. M. Hudson. *Railway Review*, November 15, 1924, v. 75, pp. 803-805. Refers to R. A. O. A. form 201, and claims its acceptance would result in great savings.

Writing the Letter That May Be Loaded With Dynamite. 658.811
C. W. Hamilton. *Sales Management*, November 1924, v. 7, pp. 1717-1718, 1805. Diplomacy needed by the sales manager in replying to complaints, and requests which must be refused.

Standardization and Research

How Division of Simplified Practice Plans Conferences with Organized Trade Bodies. 658.516
C. L. Barnum. *Taylor Society Bulletin*, October 1924, pp. 203-224. Instructions of procedure of the Division of Simplified Practice, Bureau of Standards, Department of Commerce, and covers the seven service steps for waste elimination through simplified practice.

The Masaryk Academy of Work. 6(072)
P. M. Atkins. *American Machinist*, November 27, 1924, v. 61, pp. 829-832. The history and organization of the recently established institution in the Czechoslovak Republic, founded to carry on scientific research work and to apply its findings to the practical and economic needs of the country.

Ruling Line Standards. 658.516
H. B. Lewis and C. G. Peters. *Mechanical Engineering*, Mid-November 1924, v. 46, pp. 796-798. Methods employed in the small tools department of the Brown and Sharpe Manufacturing Company, which produced a line standard free from measurable error, to be used on a measuring machine.

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Engineering Production, November 1924, v. 7, pp. 335-336. Practical notes on factory administration and executive methods.

Standardization and the Executive. 658.516
G. M. Meyncke. *Machinery*, December 1924, v. 31, pp. 273-274. Defines standardization in the machine shop, and explains the obstacles in the way of getting best results.

Training

Objectives in Commercial Engineering. 6(07)
Report of the Second Conference on Business Training for Engineers and Engineering Training for Students of Business, Pittsburgh, May 1922. Washington, Government Printing Office, 1924. 66 pp. Discussion of topics relating to the co-ordination of college training with industrial demand, the civic and social training of the engineer and business man, and the training of the engineer for management of overseas engineering projects.

A Training Program for the Factory Foreman. 658.31243
J. K. Novius. *Open Shop Review*, November 1924, v. 21, pp. 432-436. Article 12: Sources of information for the foremen group in the industrial plant.

Wages

Bonus System Applied to Tool Department. 658.3225
Iron Age, November 6, 1924, v. 114, p. 1219.

The Group Wage-Payment Plan. 658.3231
H. G. Perkins. *Society of Automotive Engineers Journal*, November 1924, v. 15, pp. 464-466. Fundamental requirements for the success of this system; outstanding results of its adoption by the Maxwell Motor Corporation—increase in productive efficiency, and improvement in employment situation.

Note on Executive Salaries. 658.312
Bulletin of the Taylor Society, October 1924, v. 9, p. 201. Tabulates and defines nine functional positions with lowest, average, medium and highest salaries paid, as disclosed by questionnaires sent to a limited number of firms of the Taylor type.

Setting Premium Rates. 658.3231
P. J. Rees. *Machinery*, December 1924, v. 31, pp. 286-288. Illus. Application in machine shops not engaged in quantity production based on predetermination of time.

Wages and the Cost of Living. 331.2
R. J. Anderson. *Industrial Management*, November 1924, v. 68, pp. 260-265. Shows the futility of attempting to base wages on a cost of living index—at best very inaccurate and unrepresentative, and claims that wages should be governed by economic law, that the market rate offered for labor is a true reflection of its real value.

Waste Reclamation

Reclaiming Brass Foundry Sands. 658.5671
F. L. Wolf and A. A. Grubb. *The Metal Industry*, November 1924, v. 22, pp. 438-441. Charts. Experiments dealing with molding sand reclamation and sand control methods in the brass foundry.

Use of Scrap Conserves Raw Materials. 658.5671
E. J. Lowry. *Iron Trade Review*, November 13, 1924, v. 75, pp. 1299-1301. Considers the increased use of scrap, the different grades for the various industries, and the substitution for pig iron.

Utilization and Prevention of Waste. 658.567
C. B. Auel. *Society of Automotive Engineers Journal*, November 1924, v. 15, pp. 407-411. Outlines activities of the materials and process engineering department, the standards committee, the disposition department, and the scrap department of the Westinghouse Company, in the prevention and utilization of waste in every form.

87 — 112

MANAGEMENT
AND
ADMINISTRATION
IN MANUFACTURING INDUSTRIES

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Twenty Years of Modern Management

Classified Knowledge Has Replaced Opinion and Guess

By DEXTER S. KIMBALL

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A FEW weeks since, the writer attended a conference of business men and educators called to discuss the possibility of teaching certain topics in schools of engineering and business. During the discussion the question arose as to whether there was a *science of business,* which reminded the writer very forcibly of the controversy that arose some years ago, and which still persists in some quarters, as to whether or not there was a *science of management.* The discussion, like most of such discussions, was not very enlightening, but there was one bright spot. The dean of a certain school of business administration made the statement that no true science can be developed in any field without study and *research,* since only through such methods can *basic principles be discovered and clearly defined.* To this I heartily subscribe.

Dexter S. Kimball

Advancing Field of Science

Furthermore, in estimating the possibilities of scientific growth in any field of human activity, it should be remembered that such growth is never an isolated movement, but forms part of the great advancing field of applied science. The great outstanding feature of modern days has been the advance in pure science, particularly chemistry and physics, and the application of old and newly discovered principles to the arts and industries. As yet there appears to be no limit to the growth of pure science, and the exploring mind of the scientist will not be satisfied, apparently, until he has penetrated to the very roots of created things and holds the secret of the universe in the hollow of his hand for the benefit of mankind.

Naturally, applied science, fed from such flowing springs, grows apace and tends to invade and reconstruct all old handicraft and empirical methods, and no man can say what will occur in any field of human endeavor. Each and every field of applied science forms only a part of this great movement that advances steadily forward, glacier-like and certain. It is true that it presents a somewhat serrated front, some lines of progress being much in advance of others, but there is movement, nevertheless, in the entire field; and progress will be diminished or will cease only because of protective reaction, political or social. Whether this movement is for the ultimate good of humanity is a question on which there are differences of opinion and will not be discussed here.

Seventy-five years ago, or less, engineering was almost wholly an empirical art. Today it is acknowledged to be a learned and honorable profession, without which modern civilization could not exist. In the lifetime of the writer, veterinary medicine has raised itself from a basis of ignorant superstition to one of the most useful of sciences. Agriculture in about the same

time has established itself well on the road toward a scientific basis in its many branches, and home economics, poultry husbandry, animal husbandry, and other fields, are rapidly gathering those fundamental scientific facts and experiences that differentiate a science from an art. Lastly comes business and boldly declares that it also has a scientific basis, and the establishment of great schools of business administration by reputable universities would indicate that there must be some truth in the assertion. As a matter of fact and experience, every human activity becomes of greater importance and rises in the scale of public estimation in proportion as it can build a foundation of basic principles from which it can predict future performances. The criterion of whether or not a calling is a science is its possession or lack of *recorded knowledge, classified and proved by experience to be trustworthy as a basis of future performance.*

The Management Movement

Every great movement in the political, social or industrial fabric always gathers cloud-like long before it is thrust forcibly before the attention of the public, and when, at last, it is so thrust forth, it is always in close connection with the work of some individual or group of individuals to whom goes the credit or blame of the movement, as the case may be. The Reformation led by Martin Luther, the Industrial Revolution ushered in by Hargreaves and every political revolution that has ever occurred, bear witness to the truth of this statement. Modern industrial management, with its scientific aspects as contrasted to the old handicraft processes, is no exception to the general rule. Long before Frederick W. Taylor announced his plan of so-called "scientific management," many of the principles on which his plan rested had been in operation. The division of administrative work by *functions* had already progressed considerably, such functionaries as engineers, accountants, shipping clerk, stores clerk, inspector, paymaster, and others were quite commonly found in industrial plants of considerable magnitude. Even time and motion study in a crude way were not unknown. And there had been for many years the example of the engineering department, where scientific analyses and prediction had already been quite fully developed. It was quite natural that the advent of trained engineers into the field of industrial management should be accompanied by growth of scientific methods and, in passing, it should be noted that practically all of the new ideas in industrial management have been the work of engineers and, for the most part, of college-trained men like Taylor.

Magnitude of Taylor's Task

These statements are not made to depreciate in any way the great work of Taylor, for whom the writer had the greatest respect and admiration. But it is essential in evaluating this movement to appreciate the depth and inertia of the current in which Taylor found himself. Like other great leaders, he gathered to himself the disconnected economic practices and principles that were floating in that current and wove them into a new philosophy of management. And a careful examination of Taylor's pronouncements reveals that for the most part his methods were based on well-tried principles. Functional foremanship, for instance, is nothing more or less than an application of division of labor, the oldest economic principle known; and, so far as economic truth is concerned, it is not open to discussion.

Experimental Stage of Management

Without the practical application of his ideas that Taylor made at Midvale and Bethlehem, the science of management would undoubtedly have long remained in the empirical and speculative state. These classical examples lifted the movement into the *experimental stage.* Without doubt, if Taylor had presented his ideas in written form, unsupported by actual practical experience, they would have made no impression upon managers; in fact, they would have been considered somewhat visionary. In working out these experiments, he made use of certain mechanisms which were admirably adapted to the particular manufacturing problems he had in mind.

If I have any criticism to make of Taylor's followers, it is their tendency to worship, so to speak, some of these mechanisms as infallible and universally applicable, which obviously is not quite true. It is true that a considerable number of these mechanisms, such as motion study, time study, balance of stores, and others, are now quite widely accepted and, as has been pointed out by L. P. Alford,[1] in his excellent review of this movement, "Ten Years' Progress in Management," the entire philosophy of pre-planning of work in advance of actual construction is now accepted as good management. So far then, steady progress has been made along the lines advocated directly by Taylor, for in its essence his principal effort was aimed at the *control of production,* with which these mechanisms are primarily concerned. These mechanisms are destined to be used very widely and in many different combinations. How closely these combinations may conform to Taylor's original models no one can say, nor does it much matter.

Broadening of Management Thinking

In my opinion these are secondary matters. The greatest and most important effect of this movement is that it has made men think as never before as concerns all phases of productive industry. I sometimes think that not enough attention is given to Taylor's other great classic "The Art of Cutting Metals". Here, again, the great effect to my mind is not the specific results he obtained nor the data he collected, but in this paper is brought out, as nowhere else, the fact that *there are no simple things in industry.* Scientists long ago found out that there

[1] See A. S. M. E. Transactions, Vol. 44, 1922.

are no simple things among natural phenomena, and this piece of experimental work, involving operations long practiced and apparently well understood, develops the complexity of all industrial operations and points out the fallacy of relying upon empirical knowledge and practical experience where accurate data are desired. It points out clearly that any operation, however small and elementary, will yield a surprising amount of background if studied analytically, or as we say "scientifically". The result of this broadening of our vision is seen in every phase of industry. Plant location, plant construction, plant equipment, plant operation, and now even the *personnel problem* in industry have become the subject of intensive analytical study in much the same manner as the background of engineering was being studied 50 years ago.

No well-informed man would predict that factory management will ever be placed upon a scientific basis comparable with engineering. But it should be remembered that much of our engineering is still somewhat empirical, and we are still sadly lacking in exact knowledge on many important points. In medicine, again, which is now rated as highly scientific by the popular mind, the background is perhaps even less scientifically developed than most physicians would care to admit. There is one infallible criterion, however, that distinguishes a science, namely, its ability to gather to itself classified knowledge and recorded experience in such a form that they can be utilized to predict future performance. It may be interesting to test this new field by this criterion.

Literature of Management

When Taylor wrote his great paper, there was little or no literature on the science of management either in general or in detail. Since that time a prodigious amount of such literature has been issued. True, much of this literature has not been very valuable, and much of it has already passed into oblivion. But on the other hand, there has been much constructive writing, some of it in fields not touched upon by Taylor's paper. Thus in the field of purchasing, so long looked upon as a matter of sharpness of wits, practically no literature bearing upon the philosophy of purchasing for industrial plants existed. Today there is a considerable amount of such material and at least two good books upon this important topic. Similar growth can be cited in many other branches of industrial management.

One of the latest and, in the opinion of the writer, the most significant addition to this literature is "Management's Handbook" edited by L. P. Alford. Here for the first time is a comprehensive digest of the literature of this subject and a record of experience in the use of the many mechanisms of management. These are not arranged to constitute any particular form of industrial organization. It is classified knowledge and recorded experience comparable with that to be found in other handbooks in other fields that have what is commonly called a scientific background. The mere reading of the chapter headings gives one a better conception as to the distance to which analytical methods are being pushed in this growing field. Even an abbreviated list of these chapter headings is beyond the scope of this article, but it marks a milestone in the progress of management. Without doubt, Taylor's prophecy that "many of the elements of management now believed to be outside the field of exact knowledge will soon be standardized, tabulated, accepted and used as are now many of the elements of engineering" has been fulfilled in a large measure.

Personnel Relations in Industry

There is one note, however, in this literature and which is reflected in this handbook, that is not traceable to the writings of Taylor, and that is the modern viewpoint of the personnel relations in industry. Taylor was a firm believer in the principle that the strong and intelligent should lead and the weaker should follow. As an end toward securing results, we will all concur in this philosophy. There can be no hope for us industrially and politically unless we possess intelligent leadership. And we shall all agree that the present situation, where labor and capital stand apart as armed camps, does not make for industrial peace and progress. The early advocates of efficiency methods assumed that the increased production due to better methods, coupled with an increase in the worker's pay, would solve this troublesome problem as borne out by the following statements taken from their writings.

> The great increase in wages which accompanies this type of management will largely eliminate the wage question as a source of dispute.
>
> The one cure, the only cure for the condition that confronts us is to increase the efficiency of the worker.

Many similar statements could be quoted. Writing[2] on this topic 13 years ago, the present writer pointed out the economic fallacy of such reasoning. Production and distribution of wealth are very different matters and, as is stated in the article to which reference is made, "all the new productive processes possible will throw little light on the problem of why we find in many places at one time storehouses filled with raw material, idle factories equipped with the finest tools the world has ever seen and people walking the streets without food or clothing, yet willing to work." The problem is not one of production and wages alone and cannot be solved by the simple expedient of increased efficiency.

The Humanizing of Management

Even while Taylor was conducting his classic experiments, there was growing up a deep-seated sentiment that there must be some solution of this problem that lies between the hard, autocratic, efficient management of the old New England factories and the hope-

[2] See "Another Side of Efficiency Engineering," *American Machinist*, August 11, 1911.

lessly inadequate and inefficient methods of socialism or communism. Taylor's great disciple, H. L. Gantt, was the first of the modern management engineers to realize this movement, and to him goes the credit of "*humanizing*" to a large degree the brilliant, efficient, yet somewhat hard methods of his great chief. This vague idea has groped its way through "welfare work," so called, has evaluated that field and left some residue of constructive ideas and a larger residue of painful experiences. It has now emerged in the form of *co-operative management,* for that in essence is exactly what the movement known variously as "industrial democracy", "works councils", "employee representation", etc., really signifies.

Now such forms of management are not quite in line with modern efficiency ideas, since this new method gives the *weak* a voice in the government of the plant and this voice, it may well be conceived, will not always speak in favor of more efficient methods, especially where these methods anticipated changes that may affect the industrial status of some workers for the worse, though *in the long run* increasing the output of product or lowering the cost of the same. It is too soon as yet to predict what this movement may bring forth. But it is a deep stream and it runs strongly. We may well believe that, if the scientific side of management progresses (and no thoughtful man doubts that it will), it must of necessity be fitted into a new environment, into a new philosophy of industrial life—*the Gospel of a New Industrial Day.*

Portable Pipe-Wrapping Machine Aids Maintenance

NUMEROUS methods of protecting wrought-iron and steel pipes have been devised and used from time to time in the attempt to prolong the life of such pipes when laid underground. Most of these methods have been effective under some conditions but would fail under others.

The need for a device of a type to make practicable the wrapping of the pipe in the field has been felt for a long time, but it was not until a short time ago, during the construction of a 6-in. gas main in Marin

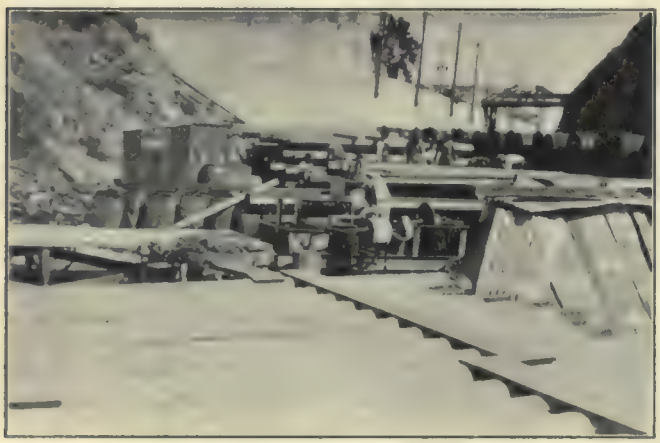

FIG. 1 GENERAL VIEW OF THE PIPE-WRAPPING MACHINE

County, California, by the Pacific Gas and Electric Company, that such a machine was perfected. This machine, designed and built by The Paraffine Companies, Inc., was used in wrapping all the 6-in. pipe laid in the level part of the route, which was the portion most in need of protection as it lay very near to the surface and came in contact with ground water.

Fig. 1 shows a general view of the pipe-wrapping machine and Fig. 2 shows a close-up view illustrating the method of operation.

The pipe to be wrapped is fed into the center of the wheel, as in Fig. 2, and this wheel, on turning, drives milled discs which grasp the pipe. These discs revolve and, at the same time, push forward the pipe. As the pipe passes through the machine, felt covering is wrapped spirally around it.

Before this covering is placed, it passes through a vat of asphalt heated to about 375 deg. fahr. The asphalt coats both sides of the felt covering and fills in the interstices of the material, serving to make it adhere to the pipe and be waterproof. Thus the pipe has a three-ply covering—a coat of asphalt, a covering of felt, and over this another coat of asphalt. The effective way in which this covering is applied to the pipe is shown in Fig. 2.

This pipe-wrapping machine is portable and consequently can be moved from place to place on work where long pipe lines are involved. For work around an industrial plant it can, of course, be located at a convenient point in the shops and from here the pipe can be moved to its place of installation.

While cast-iron pipe suffers comparatively little corrosion when placed underground, and while pure wrought-iron pipe also resists rust very effectively, steel pipe is soon attacked by the action of the elements, or by surface water if located underground. Hence for service where steel pipe is required in underground lines, this method of protection is both low in cost and effective in results over a long period.

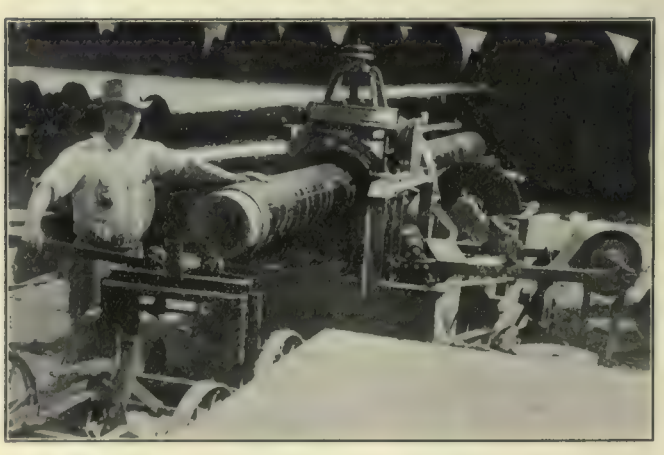

FIG. 2 CLOSE-UP VIEW SHOWING METHOD OF OPERATION

Planning the New Building

By A. G. ANDERSON

Research Engineer in Industrial Management, University of Illinois

THE modern technical organizations, which are so successfully aiding manufacturers to enlarge old plants and create new ones, were described by the writer in a previous issue.[1] In order to illustrate more definitely the character of service offered and its value to industrial executives, an outline is given below of the manner in which a particular project was handled[2] and the information which was made available to the management of the plant concerned, relative to production, costs, and financing requirements. Comparisons presented of manufacturing costs in the old plant with those estimated for the new establishment also emphasize the advantages of carrying on production operations in factories which are laid out, designed and constructed to fit individual requirements.

This particular company manufactured a line of agricultural implements consisting of four kinds of machines, and needed to expand its facilities. As the concern had grown from a small shop to a fairly large plant in a rather haphazard way in the locality where its organizer lived, it was deficient in many respects. The decision was made to build a new plant, strategically located, and designed to suit the business.

The choice of a site was influenced to an extent by an offer of aid in financing by a group of individuals who desired to attract the plant to their city. The offer was accepted after a thorough analysis indicated that the location was acceptable also from a production and distribution standpoint.

Courtesy of Turner Construction Company

FIG. 1 A. M. CREIGHTON SHOE FACTORY, LYNN, MASSACHUSETTS

In making a location survey, a market analysis was made, and, from the data secured, it was possible to ascertain the sales possibilities in the territory and to forecast sales for some years in advance. This survey indicated pretty definitely the volume of manufacturing to plan for immediately and for the future, and the localities to which shipments would be made. Bills of materials were prepared for each of the machines to be manufactured, and the total amount of each kind of raw material required for a year's output was determined. The records of the sales and purchasing departments for previous years were helpful in indicating sales centers and sources of raw materials. With this data at hand, comparisons were easily made of different possible locations, covering freight costs on materials and the total cost of materials at the the plant, and total freight charges on shipments of machines to purchasers. Such factors as labor, transportation facilities, power rates, financing, etc., could then be considered in connection with each site studied.

The production analysis made was extensive and complete. The first seven steps in this analysis were:

1. Preliminary analysis:
   Bill of material (each type of machine)
   (*a*) Name of part
   (*b*) Kind of material and weights, rough and finished
   (*c*) Number of parts used per machine
2. Operation list (in sequence):
   (*a*) Operations performed on each piece
   (*b*) Sub-assemblies
   (*c*) Final assembly
3. Equipment list

[1] See MANAGEMENT AND ADMINISTRATION, December 1924, p. 595, "Planning the Construction Program," by A. G. Anderson.

[2] By Frank D. Chase, Inc., Engineers and Architects, Chicago, by whom the writer was employed as engineer.

4. Proposed method of manufacture:
   (*a*) Operation
   (*b*) Machine used
   (*c*) Space required
   (*d*) Area and location of raw material storage, semi-finished parts and stock
5. Time analysis of each operation
6. Summary of machines required
7. Floor plan with proposed machines and routing, location of toolrooms, service and administration centers

TABLE 1. FINANCING REQUIRED

Month	Land, Buildings and Equipment (A)	Present Operation, Preparation and Moving (B)	Operation in New Plant (C)	Capacity, Per Cent (D)
June–Sept.	$300,000	$50,000		
Oct.			$ 17,122	10
Nov.			32,438	20
Dec.			60,516	40
Totals	$300,000	$50,000	$110,076	

Total of A, B, and C $460,076

Revenue from sales of manufactured product under (B)	$ 25,000
Revenue from sales of manufactured product under (C)	91,031
	$116,031

Sales schedule to meet above:

Machine	Oct.	Nov.	Dec.
No. 1	22	44	88
No. 2	18	35	70
No. 3	88	175	350
No. 4	3	7	20

The above procedure is practically self-explanatory. The first step gave information as to the number and also a description of the parts entering into the machines. It provided purchasing data. The second step provided a list of the operations to be performed upon each part in sequence. This data enabled the equipment list (3) to be made up. Knowing the machines used, space requirements for each kind could be ascertained as in (4). The production schedule was established for each month in the year, and from this the amount of raw material of each kind which it was necessary or desirable to have on hand at any one time could be determined. The amounts varied, of course, with the quantity used, cost, bulk, weight, liability of the material to deteriorate, its scarcity, difficulty of procuring, time needed to secure delivery, market conditions, purchasing quantities, storage facilities required, etc.

In like manner, from the sales schedules and production schedules were ascertained the requirements in regard to storage of semi-finished parts and of stock. Step (4) also involved a determination of the method of shop transportation in order that storage areas about the machines and aisle space might be properly allowed for. This space varied and decreased according to whether the material was transported and stored in bulk, piled regularly on trucks, handled in tote boxes, or moved unit by unit on conveying equipment.

After the manufacturing methods were established, the next step was to take time studies of each operation as in (5). This provided information enabling the proper number of machines to be selected of each kind (6), and later, for the setting of wage scales and determining of labor costs. Complete data were now available for making floor layouts and departmental arrangements as indicated in (7), and this was done.

The foregoing work was carried on by a number of men—production men, equipment, time-study and cost engineers—each performing a part in which he was experienced. The production layout represented the combined effort of the staff, and it was subject to analysis and criticism in weekly staff meetings and job conferences by production men, structural and mechanical engineers, architects and practical builders. From 18 to 25 men composed this executive staff, which was enabled to concentrate the experience and ideas gained from many industries and many constructions upon this single project.

The second part of the production analysis had to do with wages, costs and finances:

TABLE 2. PROFIT ANALYSIS, PLAN A—PER YEAR

Before paying federal taxes or dividends

Capacity, per cent	10	20	30	40	50	60	70	80	90	100
Sales	$177,453	$364,227	$550,692	$745,317	$933,894	$1,176,618	$1,372,737	$1,568,847	$1,764,951	$1,961,055
Cost of sales	205,473	389,265	561,774	726,201	868,731	1,095,582	1,233,111	1,379,145	1,549,431	1,645,986
Profit				19,116	65,163	81,036	133,926	189,702	215,629	315,069
Loss	28,020	25,038	11,082							

TABLE 3. SALES ANALYSIS—PLAN A

Per day, per month and per year

Basis	List Price		Discount per cent	Net Price
Machine No. 1	$ 13.50	less	10 and 5	$ 11.55
Machine No. 2	92.00	less	10 and 5	78.66
Machine No. 3	165.00	less	10 and 5	141.50
Machine No. 4	385.00	less	15 and 5	310.89

Capacity, per cent	10	20	30	40	50	60	70	80	90	100
Per day	$ 591.51	$ 1,214.09	$ 1,835.64	$ 2,484.39	$ 3,112.98	$ 3,922.06	$ 4,575.79	$ 5,229.49	$ 5,683.17	$ 6,536.85
Per month	14,787.75	30,352.25	45,891 00	62,109.75	77,824.50	98,051.50	114,394.75	130,737.25	147,079.25	163,421.25
Per year	177,453.00	364,227.00	550,692.00	745,317.00	933,894.00	1,176,618.00	1,372,737.00	1,568,847.00	1,764,951.00	1,961,055.00

8. Wage scales
9. Cost analysis—each operation, direct labor
10. Cost analysis—materials used
11. Cost analysis—overhead
12. Cost analysis—summary
13. Comparison of costs and selling prices
14. Revision of proposed manufacturing methods
15. Finance analysis

estimated in the new plant. The cost records in the old plant indicated the cost of direct labor plus overhead to be $26.03, while the production analysis for the new plant operating at 100 per cent capacity showed $6.86, which is 73.65 per cent less. However, the old plant was not operating at 100 per cent capacity, and if it were, the output would be considerably less than in the new plant. In order to make a more even comparison, the production analysis figures at 10 per cent capacity were taken—adding an overhead of 325 per cent—giving a cost of $14.09. This still showed a reduction in cost of 45.88 per cent.

TABLE 4. COST ANALYSIS—PER MONTH

Capacity, per cent	10	20	30	40	50	60	70	80	90	100
Material	$ 8,411.25	$17,248.50	$26,077.00	$35,349.50	$44,186.25	$55,577.75	$ 64,415.00	$ 73,617.25	$ 85,319.40	$ 92,021.75
Direct labor	2,049.75	4,219.50	6,380.75	8,679.25	10,849.25	13,738.75	15,650.75	17,961.50	20,372.25	21,818.50
Overhead	6,661.75	10,970.75	14,356.75	16,488.00	17,358.75	21,982.00	22,693.50	23,350.00	23,428.00	23,325.25
Total	$17,122.75	$32,438.75	$46,814.50	$60,516.75	$72,394.25	$91,298.50	$102,759.25	$114,928.75	$129,119.65	$137,165.50

The basic wage rates (8) for the various classes of work were established in accordance with community standards, and an estimate was made of the amount of incentive wages necessary to allow in order to call forth the best efforts of the workmen. Operation rates were then placed on a time basis, with the incentive allowance added as a time element. Thus, men could be hired on an hour basis without affecting the operation time records, and could be specially rewarded for loyalty, attendance, length of service, etc. Changes in general business conditions could be reflected in hour rates rather than by cutting established piece rates. Managers realize the advantages of this possibility.

The choice of a wage incentive system has little direct effect upon production costs. With the exercise of good judgment in setting incentive allowances and in the determination of proper task times, differences in the wages paid for work done will not vary appreciably. The choice of a wage system depends more upon the appeal which it has to the workers concerned, and the ease of its administration—for instance, as regards accounting and records.

Cost analyses for direct labor (9) and for materials (10) were readily made. The analysis of cost to cover overhead (11) required the charting on paper of the organization and its personnel complete, and calculations of expense in all of its departments. This was done, assuming various production schedules and alternate sales plans in order to note clearly the effect of overhead on costs under varying business conditions. In computing capacities from 100 per cent down to 10 per cent, the organization was reduced to an extent consistent with good business practice, considering the need of a nucleus of trained foremen and workmen when production should be increased. The percentage of overhead to apply at varying rates of production was figured to be as follows:

Plant capacity, per cent	10	20	30	40	50	60	70	80	90	100
Per cent overhead	325	260	225	190	165	160	145	130	115	107

Upon the completion of the cost analysis, 21 items were picked at random, and the total cost of their production in the old plant was compared with that

At 100 per cent capacity, the division of costs per month (12) was figured out to be as follows:

Material	67.10 per cent	$92,020.25
Direct labor	15.90 per cent	21,818.50
Overhead	17.00 per cent	23,325.25
	100.00 per cent	$137,164.00

Two sales plans were assumed, the first, A, listing one machine at $141.50 net, and the second, B, at $125. If it were possible to secure the required number of sales at the higher price, the company could break even on a 35 per cent production schedule; under plan B a 48 per cent capacity was needed.

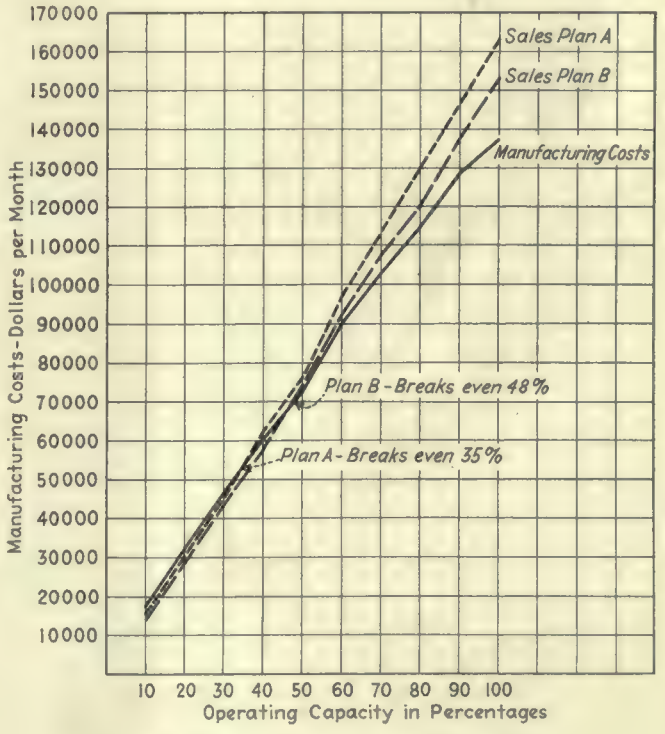

FIG. 2 MONTHLY PROFIT AND LOSS CHART

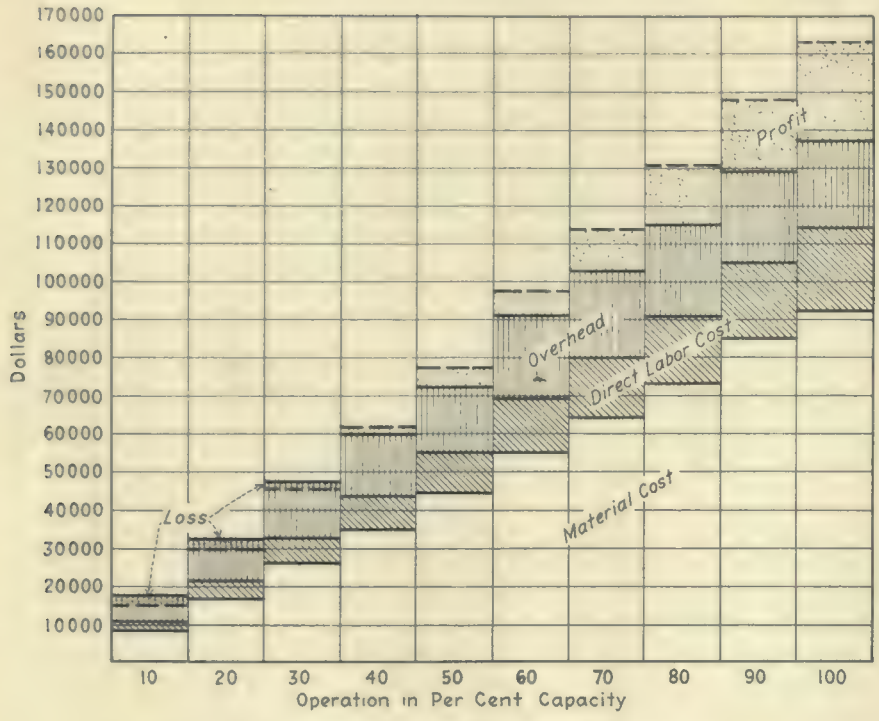

FIG. 3 COSTS AND PROFITS PLOTTED BY MONTHS

The turnover in investment was calculated for each of the sales plans, for varying production schedules, with the following comparative results:

SALES PLAN A

Plant capacity, per cent	10	20	30	40	50	60	70	80	90	100
Capital turnover	0.27	0.56	0.84	1.14	1.43	1.81	2.11	2.41	2.71	3.01

SALES PLAN B

Plant capacity, per cent	10	20	30	40	50	60	70	80	90	100
Capital turnover	0.25	0.52	0.79	1.07	1.34	1.69	1.98	2.21	2.55	2.83

Table 1 pictures the situation during the year the change was to be made into the new plant, and clearly indicates the necessary financial arrangements. Profit analyses covering production at various rates of output and for both sales bases were made; that for sales plan A being as shown in Table 2. Table 3 gives figures in connection with sales under plan A, per day, per month, and per year. A production analysis of manufacturing costs at various capacities was made and the figures obtained per day, per month and per year. Table 4 shows these costs per month.

Daily production schedules were anticipated for future years in accordance with the market analysis figures, and the decrease in labor costs on account of increased production of certain machines was calculated, and the total daily production costs of materials and direct labor were arrived at. The material presented in chart form in Figs. 2 and 3 is typical of a considerable amount of information which was made ready for the use of the executives, the idea being to provide them with as much information as could be ascertained relative to plant operation for the years just ahead. To this end, a careful study and analysis was made of the production program, sales schedules, financial needs and the necessary staff organization under varying business conditions, in order that no unforeseen contingencies might later embarrass the owners, and possibly threaten the safety of the enterprise.

Fig. 3 shows more clearly, perhaps, than figures do the operating costs and profits on a monthly basis. This chart is in accordance with sales plan A, and indicates the losses which result at low operating capacities. Fig. 2 pictures the total manufacturing costs at various operating capacities, also the profits which will result from sales according to either plan. These profits or losses are measured on vertical ordinates from the "manufacturing costs" lines, and interpreted according to the scale at the left.

The third part of the production analysis had to do with the preparation for carrying on manufacturing operations within the plant:

16. Listing of parts
17. Equipment list:
    (*a*) Jigs and fixtures
    (*b*) All machines
    (*c*) All conveying and handling equipment
    (*d*) All tools
18. Final layout of plant—machine location, department arrangement, material-handling and conveying equipment indicated, etc.
19. Final operation list—revision
20. Paper work—forms for controlling production
21. Organization of personnel
22. Design and construction of the plant
23. Install machinery and equipment
24. Manufacture
25. Manufacture—study the carrying on of actual work as planned for, and devise ways and methods for better, more economical results

The industrial executive is more familiar with this phase of the work, and little explanation is necessary. The tabulation does emphasize, however, the steps which it is necessary to take before the final layout of the plant can be made as indicated in (18).

In the design and construction of the plant, the correct technical combination of materials, choice of materials, and actual construction work, are all important; but more so is a consideration of the physical layout from every angle, considering the impress which it will make upon the human element which will operate it. Lighting, ventilation, sanitation, heating, noise, vibration, hazards, architectural design, comfortableness of floors, pleasing surroundings, nature of restrooms, locker-rooms and lunchrooms, all will have their effect upon production and contentment of the workers—the biggest single factor in industry.

Consolidated Tax Returns

Changing Attitude of the Treasury Department May Cost Industry Millions of Dollars*

By RALPH H. ALLEN

Assistant Treasurer, Thomas A. Edison, Inc.

TWO views present themselves as being of much importance in considering the application of the federal tax laws with respect to consolidated returns of corporations:

1. Large corporations with subsidiary companies are interested in having their inter-corporate relationships properly balanced.
2. Stockholders in affiliated corporations, who are few in number and frequently members of the same family, are interested in having their stockholdings properly balanced.

Justice to the taxpayer, not less than protection of the government in the collection of the revenue, must enter into the broad and constructive determination of this question. It is not one that may be disposed of upon technicalities, but merits from every viewpoint a solution that will insure to industry proper protection of its interests in an equitable as well as practical business way.

Millions of dollars of taxes are involved in the question raised by this article. It refers to what constitutes an affiliated corporate group for tax purposes; how the Treasury Department has changed its mind once and may change it again. The question must be decided in justice to the taxpayer and to protect the interests of many industrial concerns. If your corporation is part of a corporate group containing several related corporations, read it with care.

The Treasury Department, in its earlier interpretation of the tax laws, recognized the concentration of business activities, and the provisions that were made in the regulations covering the filing of consolidated returns were understood to have these very conditions in view. Now, like a thunderbolt breaks the information that the Treasury Department has revised its interpretation of the law, and views each component company in a business unit as a separate organization unless it is shown that stockholdings are uniform throughout the group, and that practically all of the stock is held by one corporation or one individual.

From 1917 to 1922 inclusive, the Treasury Department followed a liberal and practical policy, and permitted affiliated corporations to file consolidated returns when it appeared that an economic or business unit existed. Since 1922 the Department has followed the narrow and technical policy, and permitted affiliated corporations to file consolidated returns only when there was a certain legal inter-control of the stock.

In the hope that some assistance may be afforded on this important problem, this article has been prepared, not as a complete discussion and analysis of the subject, but as a general treatment of some of the outstanding features.

There was no provision in the law of 1917 for filing consolidated returns, but the Commissioner of Internal Revenue, boldly attacking the difficulty, and acting under the broad authority granted to him in the act, proceeded to make regulations governing the filing of returns by affiliated corporations, so that where conditions justified, in his opinion, consolidated returns would be accepted or required, his regulations being made only with respect to the excess profits tax, and not with respect to the income tax.

Naturally this situation was not a satisfying one, either to the government or to the taxpayer, and when the Revenue Law of 1918 was being framed the experiences derived from the previous law were availed of to overcome difficulties inherent in the 1917 law in this regard.

The provision of the 1918 law respecting consolidated returns was in the following language:

> Section 240: (a) That corporations which are affiliated within the meaning of this section shall, under regulations to be prescribed by the Commissioner, with the approval of the Secretary, make a consolidated return of net income and invested capital for the purposes of this title and Title III [excess profits tax provisions], and the taxes thereunder shall be computed and determined upon the basis of this return. . . .
>
> (b) For the purpose of this section two or more domestic corporations shall be deemed to be affiliated (1) if one corporation owns directly or controls through closely affiliated interests or by a nominee or nominees substantially all the stock of the other or others, or (2) if substantially all the stock of two or more corporations is owned or controlled by the same interests.

It will be observed that the law does not under-

* The quotations made in this article, it is believed, are entirely accurate, and reflect the exact ideas of the speakers. They are taken from the stenographic record made by Sidney C. Ormsby Company, of New York. Should it develop that there were any significant errors in transcription, copying or interpretation, it is requested that the author be advised promptly, so that rectification may be made.

take to specify in exact language the precise details of ownership on the part of a parent corporation or "same interests," the lawmakers apparently conceiving it to be impossible to lay down any hard and fast rule and leaving it to the Commissioner, through his regulations and the Treasury Department rulings, to determine an equitable basis in the individual cases that would arise.

These regulations (No. 45), contained the following elaboration of the law:

> Article 631: The provision of the statute requiring affiliated corporations to file consolidated returns is based upon the principle of levying the tax according to the true net income and invested capital of a single business enterprise, even though the business is operated through more than one corporation. Where one corporation owns the capital stock of another corporation or other corporations, or where the stock of two or more corporations is owned by the same interests, a situation results which is closely analogous to that of a business maintaining one or more branch establishments. In the latter case, because of the direct ownership of the property, the invested capital and net income of the branch form a part of the invested capital and net income of the entire organization. Where such branches or units of a business are owned or controlled through the medium of separate corporations, it is necessary to require a consolidated return in order that the invested capital and net income of the entire group may be accurately determined. Otherwise opportunity would be afforded for the evasion of taxation by the shifting of income through price fixing, charges for services and other means by which income could be arbitrarily assigned to one or another unit of the group. In other cases without a consolidated return excessive taxation might be imposed as a result of purely artificial conditions existing between corporations within a controlled group.
>
> Article 633: Corporations will be deemed to be affiliated (a) when one domestic corporation owns directly or controls through closely affiliated interests or by a nominee or nominees substantially all the stock of the other or others, or (b) when substantially all the stock of two or more domestic corporations is owned or controlled by the same interests. The words "substantially all the stock" cannot be interpreted as meaning any particular percentage, but must be construed according to the facts of the particular case. The owning or controlling of 95 per cent or more of the outstanding voting capital stock (not including stock in the treasury) at the beginning of and during the taxable year will be deemed to constitute an affiliation, within the meaning of the statute. Consolidated returns may, however, be required even though the stock ownership is less than 95 per cent. When the stock ownership is less than 95 per cent, but is in excess of 50 per cent, a full disclosure of affiliations should be made, showing all pertinent facts, including the stock owned in each subsidiary or affiliated corporation, and the percentage of such stock owned to the total outstanding. . . . The words "the same interests" shall be deemed to mean the same individual or partnership or the same individuals or partners, but when the stock of two or more corporations is owned by two or more individuals or by two or more partnerships, a consolidated return is not required unless the percentage of stock held by each individual or each partnership is substantially the same in each of the affiliated corporations.

For four years after the adoption of these regulations, a broad and liberal policy was generally pursued, and a great number of corporations had their cases disposed of upon this basis.

Gradually, however, the Treasury Department tightened up the interpretation of the intentions of Congress. Taxpayers who had not had their cases previously disposed of, when the broad policy of interpretation was in effect, were in some instances obliged to see their cases determined reversely to the earlier decisions in cases of their competitors.

Recently the Board of Tax Appeals, created by the Revenue Law of 1924, invited taxpayers interested in the problem of consolidation of tax returns to discuss the subject at an open meeting of the Board. Fifteen or more spokesmen, representing some of the best legal and accounting talent in the country, participated in this discussion, from which the quotations which follow have been taken.

Origin of the Consolidation Sections

On the subject of the origin of the consolidation sections of the Revenue Act, W. W. Spaulding said:

> The Revenue Act of 1918 was framed in conference between the Treasury Department and the committees of Congress. When there was a draft of an important provision to be made the Treasury Department submitted that draft. The Treasury Department sat in at the conferences of the Committees, even the executive sessions of both houses. The consolidation provision therefore represents the view at the time and the language at the time of the Treasury Department, no less than Congress.

The Criterion of a "Business Unit"

One of the clearest phases of the inception of the consolidation provisions is the description of the "business unit" principle, in the discussion in Congress. Upon this point Dr. Thomas G. Adams said:

> There cannot be any doubt about the purpose for which the legislation represented by the Law of 1918 was adopted. It was definitely stated by Senator Simmons, who gave more attention to the subject than any other member of Congress, to be for the purpose of taxing as an *economic unit* such businesses as were closely knit and related to each other in such a way as to permit, not unlawful evasion, but rather avoidance, and not involving any necessary connection with the so-called doctrine of "legal control." Injustice could be done even if there were no legal control involved and evasion could take place with or without legal control.
>
> In determining the basic principle, the question was really one of fact. Did an economic unit exist? If the ownership was practically identical in two corporations they might be combined if their businesses were different, even if the negligible minority were hostile. That would represent a case of ownership alone. But if there was a real economic unit, if the businesses had been originally intermingled, a test of control was inserted; and in the case of an economic unit that would be the controlling element, and should necessarily involve a liberal construction of the statute.

To require taxation of a business as a single entity, even though certain of its branches were separately

incorporated, was one of the principal purposes in the forming of the consolidation provisions. On this point J. F. Zoller made pointed statements:

Taxation of the whole business as a unit, where parts are separately incorporated, can only be brought about by including every branch controlled and operated by the same business unit as a part of one general business. Suppose corporation A is engaged in the manufacture of shoes, and owns enough of the controlling stock of corporation B to control and operate that company, which is engaged in producing leather. Suppose B owns enough stock of corporation C so as to control and operate C, which is engaged in purchasing and tanning of hides used in the manufacture of leather produced by B, and supplied to A. Would anyone seriously contend that the operations of A, B, and C did not constitute one general business carried on under the same management? It would make no difference whether the holdings of A in B or the holdings of B in C were 95 per cent or only a bare majority. So long as A controlled B and B controlled C, in the absence of fraud upon the minority interest they could all be operated as a single enterprise.

Unless all corporations operated as a single business unit are taxed as one business, then the act cannot be consistently and uniformly applied. It would be inconsistent, and certainly contrary to the intent of Congress, to tax one business consisting of say three corporations as a business unit, and fail to tax another business consisting of the same number of corporations, simply because the controlling interest in one case happened to be greater than the controlling interest in the other. If in each case there is a controlling interest and each operates as a single business then each should be taxed under the consolidated return in order to save the law from inconsistency and partiality, and to carry out the will of Congress.

What Is the Significance of "Control"?

The sections under discussion provide as a basis for consolidation "ownership or control." Perplexity surrounds the Treasury Department's interpretation of these words, and Dr. Adams gave his point of view as follows:

A matter in which tragic injustice is involved is with respect to the matter of control. A large number, if not a majority, of associated companies with which I am familiar, would find it a very easy matter to have the control of the stock acquired by the majority stockholders. It would have been easy at any time to bring such control within a ninety-nine per cent rule. They did not do this because it was inconvenient, because it would have seemed to be a changing of their normal situation designed to meet tax conditions, but it would have been comparatively easy to do it. These corporations were resting on the regulations and instructions of the Treasury Department, which not only permitted them to make consolidated returns but actually warned them that they would be consolidated by the Commissioner if they did not do it themselves. There is only one possible construction to put upon the language of those early instructions—it is a plain warning to associated corporations that they would not be permitted to take advantage of the opportunities of separate accounting, they would be treated as a consolidation.

If two corporations in their business conduct are merged, and if the relationship becomes more or less artificial, or even impossible of separate determination, and if the minority interest does not protest, but acquiesces, and if in addition it can be proved, as so many times it can be proved, that the majority interest is positively giving credit at less than the market prices, or services at less than cost, thus giving the minority pecuniary interest to be controlled, that seems to be a real clear-cut case of control through affiliated interests.

The control of a corporation under certain circumstances involves a great amount of control of the stock in question; it is obvious that the statute relates in terms only to the control of stock. It is obvious also that the decisions of the Treasury Department from the beginning have assigned considerable importance to the control of the corporation. That is best illustrated in the fact that from the beginning the Treasury Department wrote boldly into the statute the words, "voting stock." It was not there, but the Department wrote it in, and so far as I know to the contrary no taxpayer has ever protested. So far as I know there has been no objection to reading that word "voting" stock, and Congress has recently sanctioned the word by putting "voting" into the Revenue Act of 1924.

On this point also J. F. Zoller said:

That Congress had in mind control of the business through control of stock, instead of the mere control of a certain amount of stock, is established by the retroactive Act requiring consolidated returns for 1917. (Sec. 1331 of the Act of 1921.)

There are doubtless cases where owning or controlling less than a majority of the voting or controlling stock should require a consolidated return. If a substantial block of stock (less than a majority) of a corporation be held by another corporation, and the balance of the stock is widely distributed so that such block actually and in fact controls all the activities of the corporation whose stock is thus held, there is no reason to suppose that an arrangement would not be made to evade taxes by the temporary shifting of capital, profits or losses so as to reduce the tax liability. In such cases consolidation under the law should be required, the same as in cases where a larger percentage is held.

"Substantially All"

As a subsidiary element of the question relating to "control" there is the interpretation of the phrase "substantially all the stock," used in the consolidation sections of the Revenue Law. In the discussion of these words, Mr. Whittaker, of Tennessee, made the following points in support of the taxpayer's view:

The 1921 Act was passed word for word identically with that of the 1918 Act in all respects, so far as the consolidation provisions are concerned.

It is a cardinal rule of construction that all acts of Congress should be construed so as to give effect to the intent of the lawmaking body. Their intent in this case was to prevent evasion of taxation. In order to prevent it Congress said that corporations, in which the same interests hold substantially all the stock, were to file consolidated returns. There are different meanings to the word "substantial," but it seems to me, in view of the purpose in mind in the passage of the Act, the thought behind the word was as defined, I think, by a North Carolina court, "all that was necessary or essential." It has the effect of "anything that is necessary to contribute toward

the result." If that is true, then the correct meaning of the phrase, "substantially all of the stock" must be, "that amount of stock which is necessary and effectual to do the thing which Congress was undertaking to prevent."

At one time the Treasury Department was of the opinion that even a fifty per cent control would accomplish this result, and the provisions of the 1921 Act, identical with the provisions of the 1918 Act, were passed when this Treasury Decision was in effect, which provided that no definite percentage could be laid down as to what constituted substantially all the stock—that in all cases a ninety-five per cent control would amount to nearly all, but that when there was less than ninety-five, and more than fifty per cent, a full disclosure should be made so that the Treasury Department might ascertain whether or not the corporations were affiliated. In that regulation the Department recognized the fact that barely more than fifty per cent control could bring about the situation that Congress was undertaking to prevent.

With that regulation in force, and having in view the decisions of the United States Supreme Court that when an Act is passed identical with a former Act, and when there has been construction of the former Act by the Treasury Department that construction must be taken into consideration, there is a strong probability that Congress in re-enacting the provision intended that there should be placed upon it the construction that the Treasury Department had placed upon it.

Mr. Zoller made the following remarks on the significance of the words "substantially all":

When this section (240 of the 1918 Act) was debated by the Senate it contained a provision requiring consolidation of reports of foreign corporations when "substantially all the stock" of the foreign company was owned or controlled by a domestic corporation. Senator Kellogg offered an amendment substituting the words "a majority of the stock" for the words "substantially all the stock." Senator Simmons, Chairman of the Finance Committee, consented to the amendment upon the ground that the two phrases meant substantially the same thing. The discussion is given in the Congressional Record, 65th Congress, 3d Session, Vol. 57, part 1, p. 669.

Dr. Adams also made this comment:

The language of Articles 631 and 633 of Regulations 45, and the departmental instructions based on them, are all emphatic respecting the point that if detailed circumstances of associated corporations justify it, they might be compelled or allowed to make consolidated returns even if the ownership was as low as fifty-one per cent.

"Same Interests"

Where ownership or control of affiliated corporations is exercised by non-corporate interests, the statutory expression referring to them in connection with consolidated returns is "the same interests." As to the significance of this expression Mr. Spaulding said:

Affiliated interests are those interests that are so identified in interest as to preclude any independent adverse action one against the other. Identity of interests precludes independent adverse action by one against the other.

On this point Mr. Chambers offered the following illustration:

I have had the Department accept the argument that control was established where the minority interests were represented by immediate relatives of the principal stockholders and by employees. In such a decision, of course, there was no real legal control, but nevertheless the point has been accepted that in a broad sense control was established by the principal stockholders, so that they were in a position to influence the minority stockholders to accede to their wishes. For example, if the president of a corporation, incorporating the subsidiary, induced some of his friends and business associates to accept small blocks of stock on the assurance that when it came to a question of voting such stock he would be given proxies, and that the management and the business would remain in his hands exclusively, clearly in that case the business is a unit, and is managed as a unit. The control in its broad interpretation is sufficient to allow the affiliation.

Shifting Losses or Profits

One of the chief purposes of the section concerning consolidation was to prevent evasion of taxation by shifting losses or profits from one corporation to another in the same business. On this element of the case J. F. Zoller said:

The prevention of evasion was in the nature of a remedial provision, subject to the rules of statutory construction applicable to remedial statutes. The rule is (a) to consider the old law; (b) note the defects to be cured; and (c) consider the remedy provided. In construing remedial statutes they should be interpreted liberally, so as to promote the objects of the legislature, by suppressing the evil and advancing the remedy. (Cyclopaedia of Law, vol. 36, p. 1174.)

The principle of liberal interpretation of remedial statutes is upheld in a great mass of decided cases. The mischief complained of in the present instance is the evasion of taxes by shifting of capital losses and profits, and the remedy provided was the consolidated return. The construction to be put upon this statute therefore is to require a consolidated return wherever there is opportunity to evade taxes by the shifting of capital losses or profits from one corporation to another in the same business.

Summary of the Situation

For the Treasury Department to change its mind on a question so far-reaching is unjust. Moreover, it is contrary to facts to break down an actual corporate group and decide no affiliation exists, simply because the ownership of a few shares of stock appears to be vested in outsiders.

In taking this attitude the Department apparently has read into the law restrictions not contemplated by Congress, restrictions which the Department did not set up until 4 years later, restrictions which the laws themselves do not justify.

Settlement of the entire question may be easily found, if the Treasury Department will revert to its former practical interpretation of the Revenue Laws which based affiliation on whether or not the taxpayer constituted an economic or a business unit.

72% Efficiency and Good Will

Economy Plus Employee Satisfaction in a Small Power Plant

By H. BRUNNER

Production Manager, Essex Rubber Company

"MAKING WORK FASCINATING"[1] appealed to us as a very practical step toward increase in efficiency and reduction of waste. There are other means of increasing plant efficiency—by mechanical means and by disciplinary methods—but these often produce false economy, as they are generally introduced at the expense of good will of the personnel.

The power-house of the medium-sized industrial plant as a rule offers perhaps the richest field for any efforts in this direction, since it is generally given the least attention on the part of the management. In our case, we felt that we were operating considerably better than the average—still we were not entirely satisfied and, although we could not expect any phenomenal improvement in efficiency, we believed it possible to do better. Boiler-house operation under the usual conditions is not particularly enticing, and our employment records as well as the men's dispositions revealed this only too well. We had these facts in mind when we engaged the services of Walter N. Polakov to direct our efforts along the lines advocated by him in his paper. As a consequence we found that besides increasing our efficiency to a point where we can be justly proud of it, his work and the way it was performed have acted as a stimulus to the members of our own staff.

Car No.	Lb. Coal	Equivalent Evaporation	B.T.U.	Efficiency
736111 141403	218700	10.7	14282	73.0
162103 140280	219000	10.5	14235	71.8
225301 160930	215200	10.46	14100	72.0
130492 203983	215400	10.48	14100	72.2

Fig. 1 Tabulation Showing Recent Operating Data

Our equipment consists of four 250-hp. Edge Moor water-tube boilers, arranged in pairs and equipped with inclined shaking grates for hand firing. Between the settings, which are not high enough to be considered in line with good present-day practice, is a 10-ft. aisle where the feed pumps are located. In the adjoining engine-room, a venturi meter of the indicating recording type measures the amount of feed water, which averages a temperature of 210 deg. fahr.

Coal is dumped from railroad cars on a trestle into bins adjoining the boiler-room. It is taken from the bins by one man per shift by means of a Clark tructractor equipped with dump body. A small belt conveyor is used to load the truck and the coal is run into the boiler-house and dumped on the floor within shoveling distance of the fire doors. This same truck is also used for the removal of ashes. For this purpose, extra long handled shovels are used, by means of which the fireman and the coal passer transfer the ash from the ash-pit to the truck in one handling.

Previous to the changes to be described in this article, the boilers were equipped with individual turbine-driven blowers for forced draft and the usual type of chain-operated dampers. The only instruments to show operating conditions to the firemen were a recording pressure gage and a feed-water thermometer.

Our average load is approximately 1000 boiler hp. and was formerly carried with difficulty by operating all four boilers under forced draft. As in some other industries where steam is used for process work, the load fluctuates within rather wide limits, which the firemen, under the old conditions, were able neither to anticipate nor compensate. The safety valve or a sudden drop in pressure were about the only sources of information concerning the current steam demand, and information thus conveyed involved too much of a lag to be of real value.

Our problem was thus focused toward the release of employees' will to do their work better. This meant the removal of obstacles for doing high-grade work, and was thus summed up by our consultant:

1. Provide men with necessary information concerning the process and their work.
2. Substitute mental interest for physical drudgery.
3. Provide measures of excellence of work.
4. Stimulate striving for perfection.
5. Make working environment pleasant and hygienic.
6. Improve mechanical equipment.

The lack of such information on the part of the firemen furnished them with no incentive for doing their work properly, and although there were only two men to a shift, it was difficult to prevent them from following what they considered the easiest way. In addition to this, the presence of the turbo-blowers with their attendant noise and dust made working conditions anything but pleasant. In spite of these obstacles to ideal operation, the efficiency of the plant as determined by both tests and operating records averaged only a little below 65 per cent, these results being main-

[1] This was the title of the professional paper presented by Walter N. Polakov, Consulting Engineer of New York City, before the annual meeting of the American Society of Mechanical Engineers in December 1921.

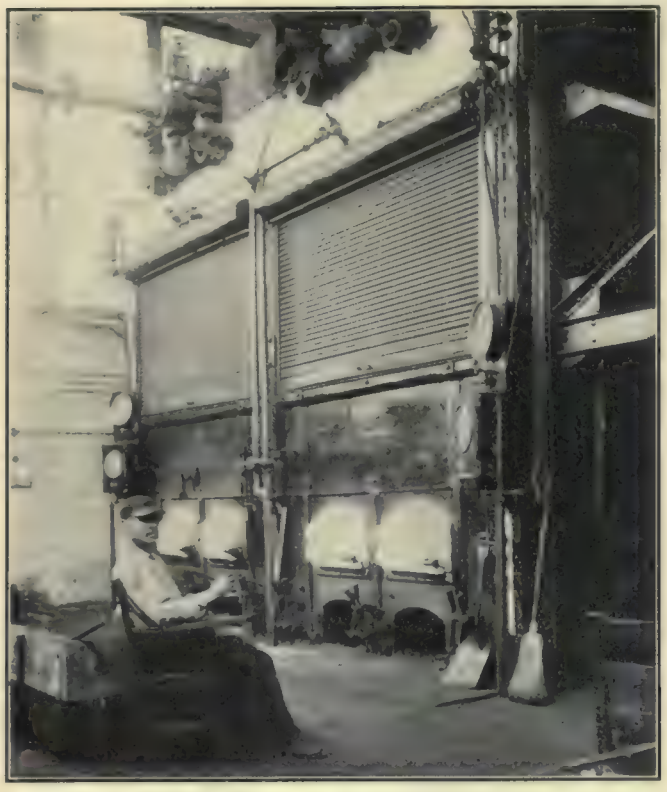

FIG. 2 VIEW OF ONE PAIR OF BOILERS SHOWING INCLINATION OF METERS

tained principally by keeping the boilers in the best condition possible under the circumstances.

However, the first improvement was made with the installation of two Bailey boiler meters of the indicating recording type, showing steam flow in percentage of boiler rating, air flow through the furnace, and flue gas temperature. These boiler meters are built on the principle that for any operating condition there is a definite ratio between steam flow and air flow at which combustion is most nearly perfect. After this ratio has been determined, the meters are set so that, when the boiler is functioning properly, the steam-flow and air-flow lines coincide. With these records before him, the fireman's job becomes one of so regulating combustion that the two pen-points keep together. Because these meters are so responsive to changing boiler conditions and record them with no appreciable lag, they have made furnace operation something of a game to the operators. Whenever a damper is adjusted, coal added, tubes blown, or any other operation performed, almost immediately the fact is recorded before the fireman's eyes, as shown in Fig. 2.

One of these meters was installed on each boiler of a pair, and one fireman on each shift was taught their purpose and use. Instruments, however, would be useless if their indications were not followed, and the adjustment of draft would be neglected if the fireman had to walk around the boiler to set the dampers and then walk back to the instruments to see if the adjustments were right. To avoid this chance of neglect, to save unnecessary effort and to combine the setting of dampers on two boilers without making an extra step, the damper controls are located in the center of the pairs, and the instruments are set at an angle with the boiler front so that their indications can be plainly seen while draft adjustment is being made. The regular chain-operated damper control was replaced by a home-made device of the screw type which, aside from ease of operation, permits of accuracy unobtainable otherwise, Fig. 3.

While at first these instruments were viewed with suspicion, it did not take long to arouse the men's interest when they showed, for instance, that one boiler was being forced while the other was loafing. Excessive flue gas temperatures under the old method of operation with blowers, as revealed by pyrometers, disclosed secondary combustion and warned of soot-covered tubes, the latter condition resulting in an installation of modern soot blowers and their regular use. Experiments were made with the idea of distributing the load uniformly over the boilers in operation, and they resulted in a decided reduction in the use of the forced draft fans.

From time to time, regular boiler trials were made under the personal direction of Mr. Polakov. Coal for and ash from each boiler were weighed separately and samples sent to a laboratory for analysis. Flue gas analyses were made at frequent intervals by means of a portable Orsat apparatus, and individual boiler output and efficiency computed from the data.

These tests were usually conducted along the lines of experiments, and a lively interest on the part of the operating force was never missing. More than once did it happen that cigars changed hands between the

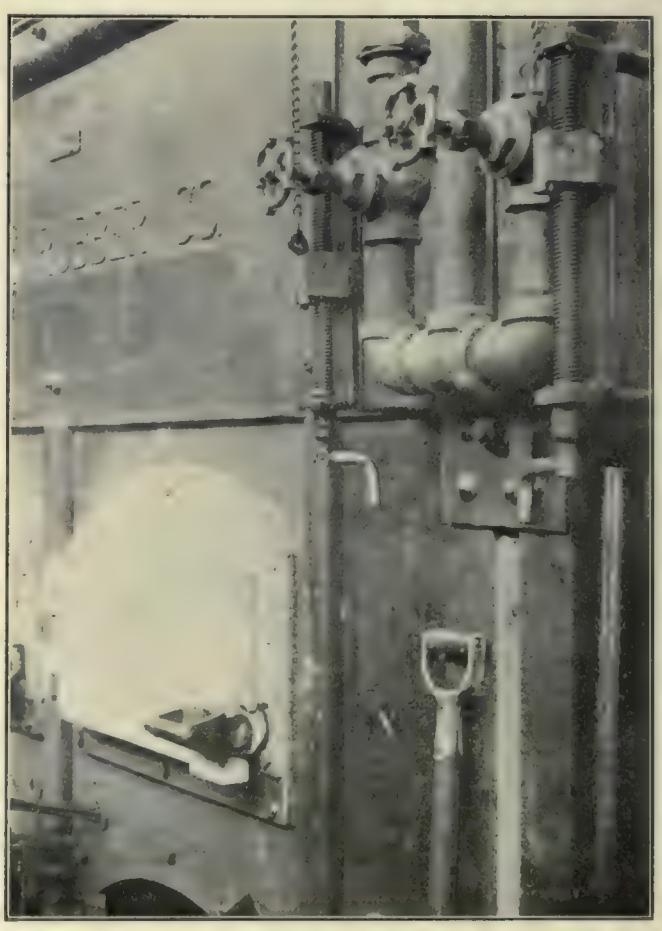

FIG. 3 CLOSE-UP VIEW OF DAMPER CONTROL DEVICE

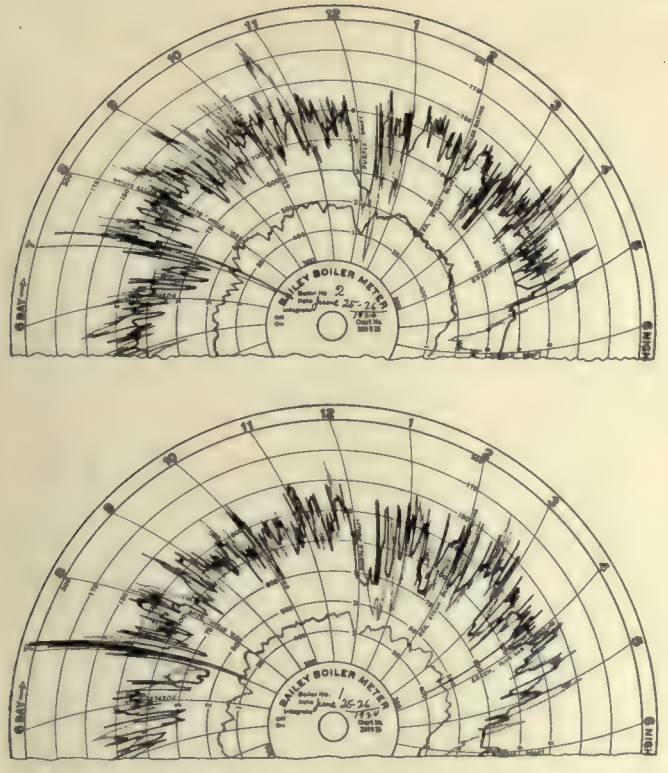

FIG. 4 CHARTS MADE FROM OPERATING TESTS IN WHICH THE UPPER CHART WAS COVERED

Solid line was blue in the original, indicating air flow; outer broken line was red, indicating steam flow; inner broken line was green, indicating flue gas temperature.

men as a result of wagers as to proper firing methods and results. An actual demand for equipping the other pair of boilers with a set of meters was made by the men, and an early installation was made. Then followed a series of tests to determine the most suitable coal for our conditions. After this had been determined from the standpoints of boiler efficiency and economy, it was found that the noisy, forced draft fans were unnecessary. Consequently, they were taken out and the openings in the setting bricked up. At the same time, we removed the ashpit doors with the idea of eliminating a temptation on the part of the firemen to regulate the draft by that means.

On several occasions, it happened that the steam pressure would fall unduly below average when shifts were changed, and the instruments soon confirmed the fact that attention to the fires was rather poor at that time. This was readily overcome by extending the shifts so as to have them overlap by one quarter of an hour. This provides ample time for the incoming crew to inspect conditions as to water level, fires, and ashpit while the outgoing crew is still at work, and allows the latter to wash up and change clothes on company time. Comfortable chairs were placed in the boiler-room so that the men could rest between handling of the fires. This privilege has not been abused, since the meters not only inform the men promptly when action becomes necessary, but also leave a permanent record for the management if action is not taken.

Interesting tests, such as covering up one of the two instruments, were made to test the acquisition of proper firing habits. At first, the covered instrument showed a wide variation between steam and air flow record, but after considerable training the gaps narrowed down to a surprisingly small degree. Records from one of these experiments show that, from the boiler fired with the aid of the meter, an evaporation approximately 10 per cent better was obtained over the one with the instrument covered. (See Fig. 4.)

Thus, with a continuous picture of the effect of everything done, together with a keen spirit of friendly competition to excel, the one-time monotonous job became interesting. This change in mental attitude has resulted in an increase of our operating efficiency to an average of over 70 per cent—a very worth-while accomplishment when it is considered that it lies in a range where such a gain is not easily attainable.

Lastly, to secure more accurate records of economy of evaporation, the coal bin was partitioned, and while one section is filled with coal, the measured coal from another section is drawn out. When it is used up, calculations are made to show evaporation per pound

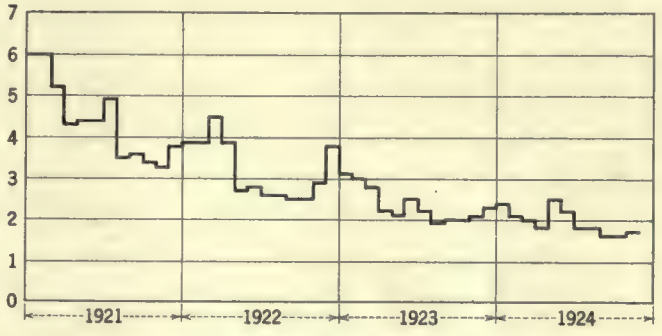

FIG. 5 COMPARATIVE CHART SHOWING IMPROVEMENT IN AMOUNT OF COAL USED PER UNIT OF PRODUCTION

of coal, and to determine boiler efficiency on the basis of coal analysis, and corrected for steam pressure and feed-water temperature. In this manner, the records of quality shown by instrument charts are checked up and supplemented by records of quantity.

It should be noted that the above described changes in boiler-room management were preceded by the overhauling of the entire steam distributing system with the idea of eliminating other sources of waste. The combined gain is illustrated in the accompanying chart, showing marked reduction of coal used per unit of production. (See Fig. 5.)

The results secured have proved that:

1. We have sufficient equipment to meet our peak loads with one boiler out of four idle but ready.
2. We have already realized monetary economies considerably above our expectations.
3. The cost of coal per unit of production has markedly decreased as shown by our chart.
4. The evaporative efficiency has increased to over 70 per cent.
5. We have secured good will of plant employees, and, have little boiler-room labor turn-over.
6. The results secured and the manner in which the methods were introduced have acted as a stimulus for further plant improvement.

Review of Industrial Standardization Developments

DURING the past year notable progress has been made in industrial standardization activities. The mechanical and mining industries and the safety movement in all industries have recorded progress particularly encouraging. Besides these industrial developments, standardization has been extended into managerial and trade-association activities both here and in Europe, and Latin America is being prepared for its introduction there.

When standardization was first considered by industry, the general practice was to make it a more or less incidental part of the engineering or production department's activities. The past year has brought forward in many concerns, especially in the larger ones, a definite organization whose sole or major duty is to diagnose and prescribe for the standardization needs of the business.

The numerous economies possible through standardization, together with the strong competition present in many industries, have made such a procedure almost essential to continued profitable operation of many companies. This emphasis on standardization has been carried considerably farther in Germany than in this country. There, more than 1000 firms have definite standardization organizations and in some of the larger companies over 100 staff members devote their full time to these activities.

An evidence of the increasing interest being displayed by American business men is seen in the increase in the number of associations and companies affiliated in the membership of the American Engineering Standards Committee. Trade associations, in particular, through which management arrives at collective industrial policies, have made standardization one of their most important and appreciated activities. About 150 such organizations are now participating in the work of the A. E. S. C. through accredited representatives.

In all, about 70 standards have been approved by the Standards Committee and about 100 others are under way. Of these, 32 concern civil engineering and the building trades; 26, mechanical engineering; 15, electrical engineering; 4, automotive subjects; 11, transportation; 1, ships and ship machinery; 14, ferrous metals; 15, non-ferrous metals; 12, chemical subjects; 2, textiles; 16, mining; 5, wood industry; 1, paper and pulp industry; and 11, topics of miscellaneous character.

The promulgation of the standard for screw threads was the most important piece of work completed during 1924 inasmuch as it is of interest to practically every industry. This was worked out by the Standards Committee in co-operation with the National Screw Thread Commission.

Considerable progress has been made in the development of standards for gages and systems of gaging, and pipe flanges and fittings. Both of these subjects are very important because of wide-spread interest in them covering nearly all industries. Parts of the work on both of these subjects are nearly ready and will soon be published.

Another subject of great importance, study of which is well advanced, is that of dimensions and tolerances for nuts and bolts. A recommendation was made at an informal conference of representatives of the American, Czecho-Slovakian, and German committees that an international conference be held on the subject with the purpose of obtaining international agreement on the proposed standards. Such an agreement would provide international interchangeability of wrenches, nuts, and bolt heads.

Technical standardization is becoming of increasing importance in matters of safety. Some 40 codes, most of which are applicable to factories, represent the progress already made in safety work. Thirteen of these have been completed and work on half the remainder is well advanced. Codes for logging and saw-mill machinery, laundries and school lighting, and a revision of the code for punch presses were completed and approved during the past year.

Foreign industrial countries are giving an ever-increasing amount of attention to standardization activities. Standardization activities in Czecho-Slovakia and Japan have shown the greatest progress among the newer national organizations. In the former 5, standards have been completed and approved and no less than 176 other subjects are being studied. In Japan, 47 projects are under way.

Latin America has given little attention to standardization work heretofore, so the Pan-American Conference on the subject, which opened in Lima, Peru, on December 23, gives promise of early developments there. The general idea for the conference originated in the Latin-American countries, proving that there is a real interest in the subject. No definite program for technical studies is expected as a result of the first conference, but through the discussions it is anticipated that the way will be paved for extremely valuable developments.

Nearly 300 specifications have been adopted by the Federal Specifications Board and are used as a basis of purchase throughout the federal government. This work has been carried on with the co-operation of the American Engineering Standards Committee which, during the past year, circulated more than 100 of these specifications for criticism in order to determine their acceptability in industry before official adoption by the government.

The Division of Simplified Practice has continued its activities. Twenty-six surveys have been completed, 10 others are in their final stage, and 45 additional are under way.

The work on the Dictionary of Specifications, being carried out by the Bureau of Standards and of Foreign and Domestic Commerce, is nearly complete, and the book will soon be ready for publication. It will consist of a classified list of all the more important purchase specifications in existence in this country. Although the work was undertaken primarily for the benefit of public purchasing bodies it should be of considerable service to industries in general as well.

Is Forecasting Worth While?

Industrial Budget Methods—V

By JOSEPH H. BARBER

Staff Assistant to the President, Walworth Manufacturing Company

RESULTS demonstrate their value if they answer to a real need.[1] The need for forecasting evolved out of attempted industrial control through budgets. Therefore, the results of forecasting are measurable in terms of its contribution toward the control of an industry.

Measurement requires some yardstick. For measuring the results of any element of business activity, one is inclined to regard "profits" as the sole yardstick. But, is it true that industrial effectiveness may be measured only in terms of profits, which trace back to price margins developed by an intricate, pulsating price structure?

Consider the problem of budgetary control and of forecasting in an industrial concern. In such a case, are not all the objective materials, submitting themselves for a tangible control, associated with demand, production and storage rates in terms of quantities, rather than in terms of profits? Nor can this be otherwise, for industry is more than mere trading for profit, and its major problem will always be to produce a volume of necessary product through the joint efforts of a balanced organization of workers. In industry, then, does the budget serve adequately as a control device if it does not stabilize the rates of production and the employment of those workers?

This is not to say that the price and profit situation may be ignored, or even relegated to second place. It is to say that, from one essential viewpoint, the prime purpose of the budget is to devise ways and means to control, to restrain, to stabilize the otherwise erratic movements of the volume of business. For, after all, even net profits depend largely upon the presence or lack of good volume, and they are enhanced if a given demand volume, more or less erratic, be translated into fairly equalized production allotments.

Thus, the budget methods we have been describing are methods that aim at sound "anticipation of consequences" that will merit executive "provision against them." It is the purpose of this concluding article to show how concretely the results of forecasting may influence executive decision. These results may counsel in many directions. Space precludes giving illustration of more than one typical instance of application, however, and the case selected will present a solution of that ever-present problem: What and how much shall we produce? How far shall we expand or liquidate stocks?

Control of production rates and control of stocks are inseparable problems. Control of stocks becomes obviously desirable not only when stocks are too high for a slack demand, but more so when they are too low for an impulsive demand. In its policies, our management strives to anticipate these demand changes, hoping thereby to avoid, on the one hand, unwarranted production rates that breed disastrous curtailments, and, on the other hand, scanty production and poorly assorted stocks that fail under temporary stress. The desire to approach stability of production—a boon to the workers and to the management alike—goads the management to surer anticipation of consequences and to adequate provision against them.

Is forecasting of real value? Does it give a safe basis for executive decisions? In the present article—the last of his series "Industrial Budget Methods"—Mr. Barber shows the operation and application of the sales forecast and reaches the general conclusion that while forecasting can never take the place of experience and judgment, used in connection with these, it can be made of the greatest practical value. The illustrations for this article are taken from the Walworth records.

These advantages can materialize only as the company's major officers in assembled committee can effectively apply a full-rounded viewpoint to the problem of what, when, and how much to produce and to carry in stock. Moreover, their judgment can be effective only if they specifically instruct the works sufficiently in advance.

To this end, near the close of each quarter, the committee reviews production data pertaining to the two succeeding quarters. Though all the data reviewed is specific and quantitative, it is, on the other hand, all estimated. Even the opening inventory is the predicted outcome of the just-ending quarter's operation. Nevertheless, upon a fact basis, separately for each product class and separately for each works, the committee approaches its study of the desirable stock-level goal at the close of the approaching two-quarter period. In their decision for each class, they balance their desire to reach a given stock-level goal against the consequences of a production rate dictated by conditions. Wisdom sometimes forces a compromise goal.

[1] See MANAGEMENT AND ADMINISTRATION for October 1924, p. 371; November 1924, p. 479; December 1924, p. 589; January 1925, p. 15.

Much, therefore, depends upon the estimate of sales and upon the prediction of the opening inventory levels. Responsibility for long-view sales estimating devolves solely upon the management, but the works may contribute toward precision in determining the probable outcome of current quarter operations. Its share lies in providing close estimates of production actually to be attained in the balance of the just-ending quarter. Such an estimate of current production, against a steady, readily-calculated daily shipments rate, makes possible a close prediction of the starting-off stock levels. Those predicted opening stock levels and the basic sales estimates resulting from planning research strike the keynote for the future planning.

The Basic Sales Estimate

Table 15 shows the form of the basic sales estimate. Such a basic estimate is made up for each works separately, and, for each important class of product manufactured by that works, there is provided a near-term estimate by months and a longer term estimate by quarters. The estimate for each product class results from the type of analysis discussed in Article IV.[2] When the total is obtained and when the amounts are plotted on the standard forecasting chart for total orders, then the forecast must look right in view of general conditions as analyzed in Article III.[3]

The table indicates that at all times we are anticipating the general aspects of the future building we construct from the materials to be found at hand. The early anticipations are somewhat hazy, and tentative detail is then furnished only as a suggestion. The details obviously will have to be confirmed as better foundation is laid and as the building of our future progresses. Always, however, we can expect a clear statement of the future's general mass outline, the position of its main supports, the approximate loads to be carried, its general purposes or aims, the advantages probably to accrue, and the nature of the problems to be faced.

How the Basic Sales Estimate Is Used

Thus, in Table 15 estimates we find at hand the most vital material for our control, and it is relatively easy to apply forecasts if they are baldly stated in quantitative amounts that merit confidence on the part of executives. The process of application is not involved, as may be indicated by an analogy drawn from engineering practice.

Engineers have long been in the habit of deducing formulas from tests and from other past experiences. They establish formulas for a definite purpose; for they proceed to conceive of something they would like to have happen, and then they simply work their formulas backwards to reveal how the several related elements must be mixed and brought together to demonstrate anew their "creative" powers.

In business, accountants record past experiences. From that wealth of recorded experience, the budget engineer deduces business formulas. Then, after setting a goal desired, he turns his formulas backward and specifies the inevitable present policy change demanded by the set goal. For the goal is an impartial taskmaster once its authority is granted.

Now, the Table 15 estimate for the class A product suggests a big swell of business in the first quarter of

[2] MANAGEMENT AND ADMINISTRATION, January 1925, p. 15.
[3] MANAGEMENT AND ADMINISTRATION, December 1924, p. 589.

TABLE 15. KEWANEE WORKS ORDERS RECEIVED ESTIMATES

(Estimated October 1, 1924)

Item	1924 Past Order Rates			Estimated 1924—4th Quarter				Estimated 1925—1st Quarter				Estimated Balance of 1925			Rated Capacity Quarterly
	Actual 1st Quar.	Actual 2nd Quar.	Predicted 3rd Quar.	Oct.	Nov.	Dec.	Total Qtr.	Jan.	Feb.	Mar.	Total Qtr.	2nd Quar.	3rd Quar.	4th Quar.	
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(K)	(L)	(M)	(P)	(R)	(S)	(T)
Product Class A.	2293	1175	1213	375	465	580	1420	1200	1050	870	3120	2200	1550	1550	2190
Product Class B.	0000	0000	0000	000	000	000	0000	0000	0000	000	0000	0000	0000	0000	0000
Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.

TABLE 16. KEWANEE WORKS WINTER PRODUCTION PROGRAM

(Calculated October 1, 1924)

Item	Inventories				Desired Liquidation During Two Quarters	Estimated Orders			Consequent Production		Estimated 4th Quarter Shipments	Consequent 1/1/25 Inventory	For Comparison Present Quarterly Production Rates = 3 × Sept. Rate
	Actual 1/1/24	Actual 7/31/24	Predicted 10/1/24	Desired 4/1/25		4th Quarter	1st Quarter	Combined	For Two Quarters	Average Quarter Rate			
	(A)	(B)	(C)	(D)	(E) (C) − (D)	(F)[1]	(G)[2]	(H) (F) + (G)	(K) (H) + (E)	(M) $\frac{(K)}{2}$	(N)[3]	(P) (C) + (M) − (N)	(Q)
Product Class A.	1622	1725	1755	1825	+ 70	1420	3120	4540	4610	2305	1130	2930	1750
Product Class B.	0000	0000	0000	0000	−0000	0000	0000	0000	0000	0000	0000	0000	0000
Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.	Etc.

[1] Figures from column G of Table 15.
[2] Figures from column M of Table 15.
[3] Fourth quarter shipments are estimated equal to 4th quarter orders, minus one-half of December orders, which proportion of December orders is usually "for shipment after January 1st."

TABLE 17. PLANNING AND STATISTICS SECTION REPORT, OCTOBER 1, 1924

PRINCIPLES UNDERLYING SUGGESTED WINTER PRODUCTION PROGRAM

The plan which we submit is founded upon the postulates listed below. The calculations are all automatic operations of a developed formula, indicated by the heading of Table 16.

1. We should produce the bulk of 1925 needs during the seasonally efficient winter period now beginning.
2. In harmony with this, we should have our highest inventories seasonally at January 1.
3. From the cycle viewpoint, on the other hand, it is well to produce requirements during the present depression or during early recovery, at the then relatively lower costs and better labor efficiencies.
4. As a sequel to (1), we must just as consciously expect seasonal liquidation of production beginning with early spring 1925, *in anticipation* of seasonally slack summer works order demand.
5. As a sequel to (3), we must consciously expect production to underrun orders while the peak ordering movement is progressing and, therefore, we should not expect production rates to imitate the sharp peak of orders. This is good sense, moreover, for the less we produce at peak costs, and the more we liquidate before the inevitable after-peak price declines, the more liquid will be our condition to weather any price or credit crises and the more readily may we later finance depression production rates higher than depression order rates.
6. We conceive of the establishment for each class of a "basic inventory"—a 100 per cent level to be used as a bench mark. For each class, "basic inventory" is the product of our present "capacity production" rate (monthly), times the class's average "quantity to order" (one month = 100 per cent), plus the class's average "margin of safety." This resulting "basic inventory" is the total class inventory that the class's regular balance of stores cards would develop if orders always came in at production capacity rates, i.e., the "basic order rate."
7. The "desired inventory" level, at the opening of any quarter, will be an inventory level which will vary from its respective "basic inventory" level only one-half as much as the anticipated quarterly order rate will vary from its respective capacity or basic order rate. Therefore, the April 1, 1925, "desired inventory" will be one-half the percentage under "basic inventory" that the second quarter comparable order rate runs in percentage under "capacity or basic ordering rates." All of which is based upon the theory that even though we may anticipate order increases six months in advance, it will be impossible, on a rising market, even from a minimum inventory of 70 per cent of capacity inventory, to increase production and inventory more sharply than half as fast as orders can and do increase. In other words, at such times we have a handicap race. Even though orders reach their lowest depths (60 per cent *under* basic), there is yet possible a potential sharp recovery. Therefore, the inventory should never be taxed with reduction to a greater extent than one-half of this maximum percentage of order decrease—or to not more than 30 per cent under "basic inventory." In the potential race up the hill, therefore, inventory is favored in the handicap by being only half as far away from basic levels as are existing order rates. It will then be hard work for orders to reach basic levels before inventory can be brought up to corresponding levels.

   On the other hand, if production rates are to be stabilized during the cycle, this infers that production rates will not imitate the wide swings of order rates and that they will, therefore, be *above* the depressed order rates in periods of bad business. This inevitably means building up stocks during depression.

   However, there should be a house-cleaning at some point during each cycle. Granted so, it must be done—and it can only be done—as peak orders are utilized to work down the inventory to desired low levels *while* the order rates are still high. Either the *rate* of curtailment of production must exceed the rate of order decline following a boom (which we are here arguing against) *or* we must resist the temptation to increase production *after* the order peak is here. If we do resist that temptation and if we do liquidate *at* the peak of orders, we shall have a clean inventory during any price crisis which follows hard upon the initial decline from peak. And, then, because of a liquid condition during and after the price crisis, we shall be able during a depression to finance production somewhere above the continued depressed rate of orders.

1925. If the view ahead penetrated no further, we should be looking forward to much "busyness" then, and would think it good business to increase production at once to comparable levels. Then, since modern business is equipped with four-wheel brakes, we should depend upon applying them effectively some time next spring, should an emergency then become a definite near-term anticipation.

Fitting Production to Sales Requirements

Some have said that business administration is just knowing when to say "Stop!" or "Go!" But there is more to business than just "busyness", which may last as long and only as long as conditions will permit. We re-answer our original question, "What is business?" Is it not a part of our business to get the steadiest production (and, therefore, the greatest possible profit under given conditions) that may be attained under the long-view conditions forecast, even though the order rate be very erratic? Must we not, as does the engineer, work our formulas backwards to discover what must be done to attain the goal we have in view?

Table 16 shows this process, and Table 17 reproduces a statement of principles involved in the solution suggested to the executives by the planning section. In the calculation, stock on hand at the beginning of the period, and desired stock on hand at the end become the limit points. In column M, we find the average quarterly production rate which will give us steady production, which will leave a desirable inventory at the end (column D), and which, per column P, will necessarily provide a large inventory by January 1st, just prior to the peak of the anticipated boom. Moreover, since the suggested second-quarter-1925 order rate (column P of Table 15) about equals the even-production rate calculated for the coming two quarters (column M of Table 16), almost horizontal production can probably be sustained for a full nine months.

The True Place of Charts and Formulas

In attempting to be specific throughout this series of discussions, it is possible that statistical technique may have been stressed at the expense of due emphasis of management's dependence, all the way along the line, upon sound judgment developed after long experience. Possibly it may have appeared that we regard charts and formulas as automatic devices fully adequate for business guidance.

Of course, we shall be guilty of distorted perspective and of gross negligence if we fail to leave a final impression that all these devices are but handy tools to be used in trained hands. They serve only as starting points in the line of executive thought. The things that can be measured weigh against those that cannot be, and decision always results from a mental process more or less vague. Executive decisions should reflect a harmony of many opinions and a merging of many viewpoints.

The Record of Decisions—the Check-Up

In the solution of this particular problem of control, Table 18 shows the standard form for recording the several decisions of various experienced executives, as each agrees to the planning section's estimates by inserting a check-mark, or suggests changing them to some specific revised amounts. This form is provided for each important product class, separately for each works, and the planning section's amounts are copied over from Table 16 calculation.

The procedure by which these forms are completed is more fully described in other discussions.[4] We must not fail at this point, however, to stress the fact that statistical inferences, though they provide a firmer basis for judgment, do not and cannot in any sense replace the wisdom gained from long experience.

When a plan, satisfactory to all major executives concerned, has been agreed upon through their joint

[4] "Coordination of Sales and Production," by the author, *Bulletin of the Taylor Society*, June 1924, Vol. IX, No. 3.

committee decision, once more statistical routine does provide a means of prompt check-up performance against estimate. In this connection, it will be interesting to note our auditor's September 30th finished stock figures, the latest available for checking up a recent stock control program. For the combined works, these actual figures check up against the planned amounts as shown in Table 19, the absolute quantities of which have been somewhat disguised by multiplying all figures in the table by the same constant.

The Budget as a Stabilizer

Now to answer more directly our earlier question: Does the budget, or does any planning mechanism, serve adequately as a control device if it does not stabilize production rates for the management and employment for the worker?

Does not budgeting—planning—at one and the same time help both the manager and the worker, for do not both want most the same identical thing? Is it not true, that, in spite of the fickleness of customer demand, they both want steadiness? The manager wants steady employment of his capital—his money invested in tools—and this *cannot be* without a consequent steady employment of his workers. Moreover, his natural comradeship, as man to man, should make him want to give his employees the steady, continued employment that will make them his happy, contented, co-workers in a single-purposed enterprise.

Our discussion of some of the processes of budgeting has been somewhat technical; yet the aim of budgeting may be understood by all. The technical processes need not be generally understood, but their value should be demonstrated to justify their existence. If they justify a valuable existence, then budget workers may claim that they, too, have shared with the other workers in the single purpose that is the common aim of manager and worker alike.

What Budgeting Does for the Producer

The final test of planning then is: Does it, or does it not, aid in steadying the output for the manager and the work for the worker?

TABLE 19. COMPARISON OF PLANNED VERSUS ACTUAL STOCK ON HAND

For September 30, 1924

ITEM	SEPTEMBER 30 STOCK AS PLANNED JUNE 24	SEPTEMBER 30 AUDITOR'S RECORD NOW
Product Class A	3030	2738
Product Class B	3170	3447
Product Class D	860	934
Product Class E	1130	844
Product Class F	300	241
Product Class H	290	230
Product Class K	180	294
Product Class M	120	101
Product Class R	260	264
Product Class S	820	893
Product Class U	250	402
Product Class W	510	467
Product Class X	80	53
Total of All Classes Shown	11000	10908
Total of All Other Classes	390	631
Grand Total	11390	11539

The first of the three sections of Fig. 34 shows the up-and-down course of our total customers' orders received. Such an up-and-down course is almost the only guide to tell us what quantities we should produce. Each month, since 1919, the course of the line is fixed by the quantity of business our customers gave us month by month. There was a great swell in 1919 and 1920. There was a great shrinkage in 1921. Since then there was another swell practically as great as the earlier one. But notice that its curve-shape was even more jagged.

Now look at the curve of our employment — the number of workers maintained to produce the goods, as shown in the second section of the chart. It is drawn to a scale that is exactly proportional to the order scale in the first section. Note that the size of the 1919-to-1920 swell in our employment and the later 1921 collapse were almost exactly the same as for the orders. It had to be. Without budget forecasting, we had to produce, but only the amounts our customers wanted, and only when they wanted it and could pay the bills.

But, by 1922, budgeting foundations were well laid, and we were surveying the future. Statistically derived plans more and more became a guide for our executives. And note that in the last three years, while our customers seem to have bought more haphazardly than in 1919-1920, nevertheless employment has been noticeably steadier.

TABLE 18. ORDERS, PRODUCTION AND INVENTORY ESTIMATES, PRODUCT CLASS A

Kewanee Works

ITEM	INVENTORY AT 10/1/24	4TH QUARTER ESTIMATE				INVENTORY AT 1/1/25	1ST QUARTER ESTIMATE				INVENTORY AT 4/1/25	FOR COMPARISON: 2ND QUARTER ORDER ESTIMATE
		Orders	Controlling Balance				Orders	Controlling Balance				
			Shipments	Production	Difference			Shipments	Production	Difference		
Planning	1755	1420	1130	2305	+1175	2930	3120	3410	2305	−1105	1825	2200
Sales*	√	1500	1250	√	+1055	2810	3500	3750	2740	−1010	1800	√
Production	√	√	√	2492	+1362	3117	√	√	2493	− 917	2200	√
Ass't to President	√	1560	1200	2400	+1200	2955	3430	3790	2685	−1105	1850	√
President	√	2070	1670	2495	+ 825	2580	√	3520	2765	− 755	√	√
Committee	√	2070	1670	2495	+ 825	2580	√	3520	2765	− 755	√	√

* √ = Agreement with planning estimate

Standards

Capacity Production and Basic Order Rate = { 2190 Tons Per Quarter / 730 Tons Per Month

Basic Inventory ..... 1825 Tons

(Capacity production can be exceeded during short periods)

Yet that is not all. Note further that the number employed now is barely at about the middle or average level for the whole period. We have not been led to those severe expansions which simply could not be made permanent.

And still one more point needs emphasis. The workers we had stuck with us in our time of greatest need. They were happy and contented. They dug in with a will and produced as much each year on the average during the 1922-1924 boom as they did in the 1919-1920 boom—but they did it with a much smaller group of workers. Their loyalty and co-operation, their better training and increased effectiveness in steady jobs have made it possible for them to share more largely the dollars our customers have paid for the product of our common effort.

What Budgeting Does for the Consumer

Charts might be multiplied, but these shown should justify our confidence in the contribution that budgeting and forecasting may make in serving our singleness of purpose. Yet the profit to manager and worker only cannot be made at the sacrifice of better-than-adequate service to the customer, the one who pays all the bills. Is budgeting of value to him? Has it served him?

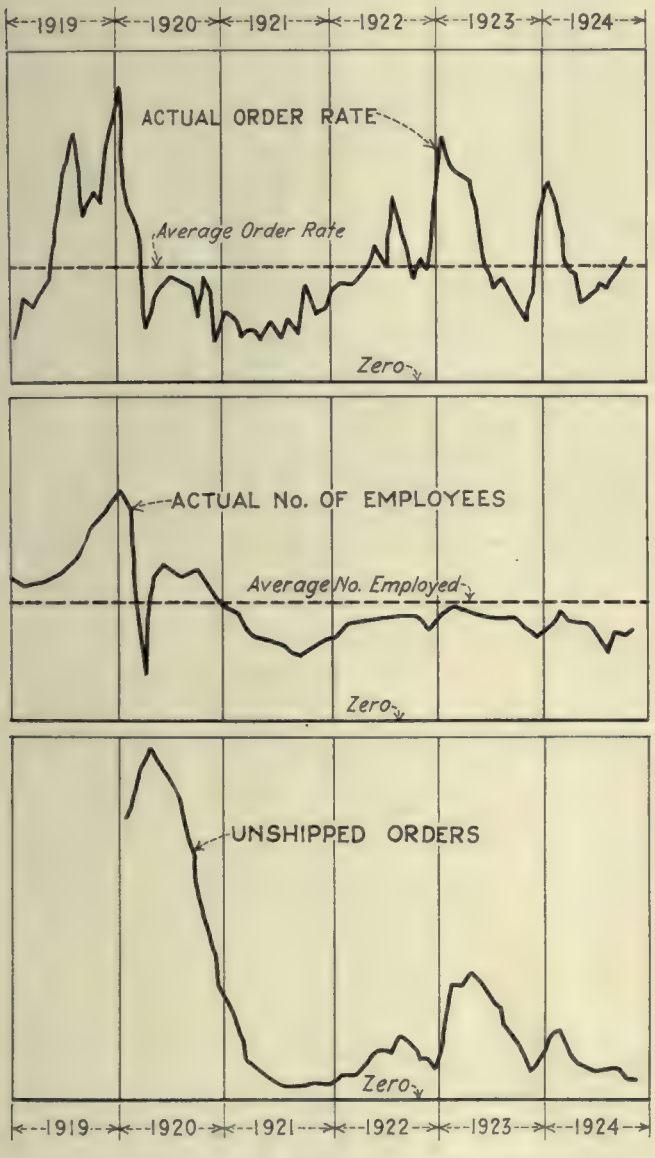

FIG. 34 COMPARISON OF DEMAND, EMPLOYMENT AND UNSHIPPED ORDERS

This is answered by the chart's final section, also drawn to a scale exact for comparison with the chart of orders. It shows the amount of unshipped orders at the end of each month. In 1920, without forward planning, the flood of orders that did come, came before the newly hired workers had learned how to produce goods fast enough to meet the unexpectedly great demand.

Yet, in the last three years, since the budget has been serving, in spite of the unreasonably jumpy curve of orders and in spite of the fact that employment has not been greatly increased, better service has been given the customer, and unshipped business has never been as great as before the establishment of budgetary control—a result that seems to justify entirely the trouble and expense involved.

The Future of Budgetary Control

Some day, in the not-too-distant future, we may hope that men will learn to lay their business "cards upon the table". Some day, the facts and figures of production and of trade will be freely revealed for keen wits to deduce their meaning and their implied direction. Some day, customers' purchases against the future, and workers' production against customers' purchases, can be smoothly gaged in the light of real day-to-day needs. Some day, when production and trade flow smoothly, both worker and manager shall share a just recompense for joint efforts in serving the customer at no greater than a fair price to him. And in that day, the best achievement will be that the worker, the manager and the customer alike will *know* that no one has profited at the cost of the other—that the ends of justice are served.

Our budgeting results give us a little foretaste of all this. Facts at hand for planning are yet relatively scant when compared with facts that could be profitably used. But such as are at hand are being used. And our experience proves that budgeting does help the worker toward a steadier job at better pay, the manager toward more effective use of the tools of production, and the customer toward prompter shipment at lower prices for an even better quality in the goods that serve his needs.

The foregoing article completes Mr. Barber's discussion of forecasting practices. Beginning with the October number of MANAGEMENT AND ADMINISTRATION in five articles he has described with all its working detail the statistical method of forecasting so successfully employed in the operations of the Walworth Manufacturing Company. While the methods used are those adapted to Mr. Barber's own company, they may be modified without any great difficulty to meet the requirements of other lines of manufacture.

Handling and Storing Oil and Gasoline

THE Market Street Railway in San Francisco, operating several power-houses and car barns, in each of which oil is used as a fuel, has found a specially built tank car, Fig. 1, a profitable investment. This car has a capacity of 5500 gal. The main supply tank for feeding the various power-houses and car barns is located underground at a central point. Here a steam pump is used to fill the tank car, and the oil is then transported over the company's lines to one of the outlying stations.

When it comes to the individual manufacturing plant, especially where oil is used for lubrication, the quantities handled are much smaller. Nevertheless, both for safety and economy, special provision for the handling of oil is advisable. There is no use of neglecting a fire hazard and a source of possible waste.

FIG. 1 TANK CAR FOR HANDLING FUEL OIL

At the plant of the Associated Oil Company, in San Francisco, six different kinds of light oils are carried in stock. These oils are contained in 50-gal. tanks located over the toolroom, and filled by a rotary electric pump. One-inch pipes lead into the stockroom, which is the distributing point. The system operates by gravity.

Each pipe is provided with a faucet for delivering the oil, as is shown in Fig. 2. The individual oil cans and receptacles are filled from these faucets, and a brass drip pan below catches any overflow or drops. The faucets are locked with a sliding bar, which in turn is locked to the first faucet. Shut-off valves are placed in each line for use in cases of emergency when repairs must be made to the faucets. These are visible in the illustration about 15 in. above the faucets.

FIG. 2 HANDLING OIL IN THE STOREROOM

A very handy device by means of which one man can fill drums with gasoline quickly and easily is shown in Fig. 3. This piece of apparatus is used at the S. T. Johnson Oil Company, of Oakland. It consists of lengths of pipe fastened together by fittings and connected to the source of gasoline supply. Flexibility is obtained by carrying the piping to a height of about 18 ft. to a short horizontal section and then down again. It thus turns, at three joints, sufficient to give ample adjustment, but not enough to allow leakage. The weight of this overhead piping is counterbalanced by a rope and counterweight suspended from a beam on the roof.

FIG. 3 ONE-MAN DEVICE FOR FILLING GASOLINE DRUMS

Drums are placed on an elevated concrete platform, and a short scetion of rubber hose on the end of the pipe is introduced into them. Discharge is regulated by a quick-shut-off valve attached just above the hose connection. The main valve is placed at the point where the flexible filling apparatus joins the main supply line. During the periods when no drums are ready for filling this latter valve is shut off.

Burroughs Differential Wage Plan Meets Every Requirement

Wage Adjustments Made Without Friction

By V. R. BECHTEL

Burroughs Adding Machine Company

THE Burroughs Adding Machine Company has developed and adopted a differential wage payment plan which has been notably successful during the two years of its operation. It has met our requirements in every way, has secured a greater production at a lowered cost, has created satisfaction and stimulated enterprise in the working force and permits adjustment of wages, up or down to meet conditions, without undue friction.

The plan as adopted was developed after a thorough

Time Observation

Date 12-5-23 Dept. 15 Symbol 848 #15

Operation Cups 26 + 54

Size and Kind of Stock 1 11/16-1112 G Mach. #2 B+S. Ledger Number 95400

Tools	Spd'l Speed 1000	Tools	Spd'l Speed
1/2" Drill	✓H. S. Carb.		H. S. Carb.
.252 "	✓H. S. Carb.		H. S. Carb.
.256 Reamer	✓H. S. Carb.		H. S. Carb.

Feed Tools O. K.

Loading Time per Piece Cutting Timing Ave 22 minutes

Pieces per Pan 250 Previous Record 25 Min.=1 Hr. 55 Performance C Class Rate .62

Badge No. 15099 Set Up Task Time 35

Name Romman Production Task Per Hr. 22

Timed by Sattby 27 22 Oper. By Men Rate per 100 2.818

Foreman's O. K. R. K. Jones Approved De Vaelbiss

Code	Operation Analysis
A	Length of time to check one piece
B	Accumulated time plus length of time to drill " " 1/2" drill
C	" " " " " " " cup rough " "
D	" " " " " " " finish " "
E	" " " " " " " drill " " .252 drill
F	" " " " " " " ream " " .256 reamer
G	" " " " " " " face " " cut with tool #1
H	" " " " " " " unload
✱	" " " " " " test one in ten

FIG. 1 OPERATION ANALYSIS SHEET

examination and analysis of various piece-work, premium and bonus plans in use. The particular nature and requirements of our own business, and our own previous experience with war and pre-war piece-work, were also carefully weighed.

There is just one reason for the introduction of a differential wage payment plan into any business. That reason is the desire to secure greater production at a lesser cost. It was evident from the beginning, in this preliminary work, that any plan adopted must have inherent certain essential prerequisites:

1. Quality of the product must be protected.
2. Employees must be assured of increased earnings.
3. Increased earnings must be proportionate to increase in production.
4. There must be no limit to earnings of an individual employee.
5. Loss of time due to no fault of employee must be paid for.
6. Allowance must me made for fatigue on each job.
7. Ideas, suggestions, and improvements from workers must be encouraged and rewarded.
8. The wage plan must be easily understood by the rank and file worker.
9. The plan must be simple and inexpensive to operate.
10. The plan must be flexible, to conform to economic changes as well as to changes in manufacturing methods and conditions.
11. The time required for setting up or getting the job started must be divorced from the running time on the job to protect both the worker and the company against changes in size of lots.

Separating the "Variables" and the "Constants"

Experience has proved that in all wage payment plans, certain factors are constants, others variables. The standard time required to perform a certain definite manufacturing operation changes only when manufacturing methods change; therefore, it is regarded as a constant. Wages fluctuate in step with the fluctuation of the cost of living, and with economic and seasonal conditions; therefore, they are considered variable. Our method of practical and economical handling of both variables and constants provides a fair and satisfactory wage basis to both the employee and the company.

An hourly rate was established for each class of work, this rate being approximately the rate necessary to pay to secure workers to perform each class of work on an hourly rate basis.

New employees were employed on an hourly rate basis by individual bargaining at the employment office, but always at a rate somewhat below the class rate for the class of work they were to perform. As soon as a new employee demonstrated that he could consistently turn out work of the proper quality and in sufficient quantity to earn more on a piece-work basis than on his hourly rate, he was changed to a piece-work basis and automatically advanced to the class rate assigned to his class of work.

Setting the Task

Tasks are set in number of pieces per hour for each operation by scientific time study in the following manner: Time study men, selected from the best of the productive workers, were equipped with stop watches and time study forms, and, after being thoroughly drilled on the method of study, were sent into the departments where they were most familiar with the work, and the study and analysis of each job was started. The length of time for setting up or getting the job started is first analyzed, and a task or allowance to the nearest one-tenth hour is set on each and every job, consideration being given, in addition to the actual setting up of the machine and tools, to running, and getting the inspection and standard O K's on the first piece, also for getting into the swing of the job itself.

Checking the Equipment

The kind of machine and the condition of the die or tools were next checked up by the time study man, in order to satisfy himself that the work was being run under satisfactory equipment conditions. He may find, if the job is being run on a drill press, that five holes are to be drilled, and that the work is being run on a three-spindle press instead of a five-spindle press, thereby necessitating two operations; or perhaps the person setting up the job has thoughtlessly secured ordinary carbon drills to run the job where the blue-print calls for the use of high-speed drills, the result being much lost time due to grinding and breakage and a material slowing up of the actual performance of the operation, inasmuch as the operator must be very careful in forcing the drill through the part. The speed and feed of the machine are checked to the requirements set by the engineering department.

The actual performance of the operation is then broken down into the various integral parts or motions. Each motion is studied to determine if it is essential, or the most efficient. This is quite important with us, as the greater part of our work is small and very close, and the actual amount of time spent in loading, unloading, wrapping, piling, etc., is large in comparison with the time required to perform the actual machining operation itself. For this reason, motions that might ordinarily be of very little consequence, however they might be done, are to us very important. For example, six inches additional movement of the arm, because of the distance from the pan of work to the loading and unloading position of the machine, multiplied by as much as 5000 to 10,000 pieces per day, is quite an item.

The analysis of the operation, Fig. 1, into motions is then timed, as shown in Fig. 2, showing the accumulated time from motion to motion in seconds, also the time over all. Sufficient number of pieces are timed to make sure of securing proper results. (The number will depend on the time required to perform the complete operation, but never less than 4 or 5, up to a maximum of 30 to 40.) The time study man, being a graduate from the rank and file, knows instantly when an operator is lying down on the job. If such a thing happens, either a new man is secured to run the job or the time study man runs it himself. An employee caught lying down on the job is severely taken to task by his foreman, and, in extreme cases, dismissal is the result. Workers take more kindly to tasks and accept, without kicking, stiffer tasks if set by one who has been a fellow workman and who knows the work thoroughly, than they would by a differently trained, or, as the workers put it, a "white collar" man.

After the required number of complete operations are studied, the unreasonably high or low timings are thrown out. To the average of the remaining timings is added the time study covering the inspection, if any is given by the workman. The time per piece is then divided into the number of minutes in each hour less the allowance in minutes for fatigue on that par-

Motion Timing

Date 12-5-23 Symbol 848 #15

Operation

Code	R	E	R	E	R	E	R	E	R	E	R	E	R	E
A	40		50		20		20		20		40		25	
B	90		100		75		80		88		90		86	
C	130		140		108		130		130		131		145	
D	160		170		180		160		175		168		180	
E	168		178		138		172		182		175		188	
F	178		186		148		182		191		180		198	
G	198		205		165		200		210		202		220	
H	210		220		180		220		230		220		240	
*							40							

	Time per Piece			Average Time	Min.=1 Hr.	Par Performance	Task
	1. 2.17 av .04 inst 2.21 av	2.	3.	2.21	55	24.9 plus 10% % C performance = 27.4	21.9 or 22 (80% of 27.4)

FIG. 2 TIME STUDY SHEET

ALLOWANCES FOR FATIGUE BY CLASSES OF WORK

Dept.	Class of Work	Allowance in Minutes Per Hr.	Working Minutes Per Hr.
1	Riveting and staking	3	57
2	Milling	10	50
	Gear cutting	3	57
	Profiling	6	54
5	Punch press blanking and heavy 2nd operation	7–12	48–53
7	Polishing—1st grade	10–20	40–50
	Buffing	8	52
	Polishing (screw)	10	50
8	Assembling, transferring, filling and wrapping	6	54
	Sanding, filling and rubbing	3	57
	Transferring on cases	3	57
	Assembling release keys and panels in cases	3	57
9	Scratch brushing	3	57
10	Light spring making	6	54
	Heavy spring assembling and cutting on punch press	3	57
11	Speed lathe, motor burr, and screw slotting	3	57
12	Drilling heavy casting	3–10	50–57
	Milling heavy casting	3	57
	Profiling heavy casting	6	54
15	Screw machine—1st class	5	55
	Screw machine—2nd class	5	55
16	Straightening, testing, etc.	3	57
20	Sub-assembling of carriage parts	3	57
	Assembling dial wheel, key buttons, stop dogs and motor cords	6	54
21	Burr and co-sink type	6	54
	Arbor press type	3	57
	Milling type	3	57
	Kneading type	6	54
	Punch press	3	57
27	Drilling—all except heavy casting and sections	3–5	55–57
	Spinning machines	3	57
28	Assembling motors	3	57
	Assembling time switch	6	54
29	Grinding external work	6	54
	Grinding surface work	6	54
	Grinding bench and disc	3	57
30	Snagging, straightening, fitting to jig-assembly	3	57
	Bench grinding	3	57
	Milling cases	3	57
	Profiling cases	6	54
	Polishing cases and bases	10	50
	Spot welding	3	57
	Drilling	3	57
31	Light assembling	3	57
	Sub-assembling	3	57
	Drill sections	3	57
32	Nickle plating (wiring)	6	54
35	Hand burring	6	54
	Motor burring	6	54
	Arbor press	6	54
	Light assembling	6	54
	Bench drill press	6	54
	Heavy duty arbor press	3	57
36	Assembling key buttons and hook springs	6	54
52	Burring	6	54
	Arbor press	6	54
	Assembling	6	54
	Riveting	3	57
	Drilling	3	57
	Arbor press	3	57
	Straighten, test and assemble	3	57
	Punch press	3	57
	Turning lathe	3	57
55	Punch press, 2nd operation	7–12	48–53
	Motor and hand-burring	6	54
70	Roll paper manufacturing	..	..
		(Gang Piece Work)	

FIG. 3 ALLOWANCES FOR FATIGUE BY CLASSES OF WORK

ticular class of work, to determine the actual working hour in minutes, Fig. 3. The time study man then rates the operator as an A, B, or C operator. An "A" rating is exceptionally fast and is discounted 10 per cent. A "B" rating is considered the average and is accepted as par performance. A "C" rating is slow and is increased 10 per cent. In other words, the establishing of the par performance on each job is based on the work of an average operator.

The task in number of pieces per hour necessary for the operator to produce to earn the class rate is set at 80 per cent of the par performance. This is done to enable the average worker to secure his class rate by merely doing the task set. Each 1 per cent increase or decrease in production above or below the task set increases or decreases the operator's earnings a corresponding 1 per cent. It is possible, and is expected, that an average operator will earn up to 25 per cent above his class rate per hour. To do this, it is only necessary that he turn out par performance. Exceptionally fast operators are able to produce as high as 50 per cent over the task set, thereby increasing their earnings a corresponding percentage over their class rate. Putting this into figures, a task of 100 pieces per hour is set. The operator's class rate for the class of work he is doing is 60 cents per hour. By doing 100 pieces per hour he earns 60 cents per hour. By doing 125 pieces per hour (which is par performance) he increases his production 25 per cent over his task, also his earnings 25 per cent, or to 75 cents per hour. By doing 150 pieces per hour, an increase of 50 per cent in production, he automatically increases his earnings to 90 cents per hour.

This is one of the required factors — the operator must benefit through increased production in exactly the same proportion that the company benefits. The operators who turn out the largest amount of production, maintaining the quality throughout, are the money makers for themselves through increased earnings and for the company through the saving in overhead.

Maintaining Quality

The only limits to the quantity of work an operator may turn out are quality of the product and safety and protection to the operator and equipment, but these limits are very rigidly enforced. The quality is maintained by an extensive inspection division, where all parts below standard are rejected either for repairs or scrap. The operator who is personally responsible for rejects or scrap actually loses from his pay the cost of repairing rejected work, or, in case of scrap, labor paid on the part up to and including the operation on which he spoiled the work, plus the material cost. It will be seen, therefore, that, while the operator is encouraged to produce all possible, he is made personally responsible for the quality of his

MASTER RATE CARD

Date June 18-23 Stock 1 11/16-1112 G Symbol 848 Sty 15

Serial 4 Ledger No. 95400 Ft. per 1000 88 Time 110 Sec. Stocked in Dept. 6

Large Pan 250 Reason for Change

Small Pan

Truck

Tray

Rerouting

Dept.	Operations	Date	Mach.	T/P	Set-up Time	Task Per Hour	Date	Mach.	T/P	Set-up Time	Task Per Hour	Time (Hrs.) 100 Pcs.
11	32 Cup & 84,77 & 23											
15	Cup 26 & 54 (M)	12-5-23		P.	3.5	22.						
9	104											
27	26 Wrench & Vent holes (M)	7-27-23		P.	.4	40.						
35	10 Vent & Center holes (M)	11-27-23		P.		110.						
993	104											
363	380											

FIG. 4 MASTER RATE CARD

work through the only really effective means—a reduction in his earnings for work below standard.

Final Approval of Rate

After the time study man has set the task, the time study sheet is checked with the department foreman and approved by him and by the head of the time

Dept.	Symbol
15	848 Sty. 15.

	Dept.	Operation	Date	Set-up Time	Production Task Per Hr.	Rate Per 100 Pcs.
P		Cup 26 & 54 (M)	12-5-23	3.5	22.	

FIG. 5. DEPARTMENTAL RATE CARD

study department before being made effective. After being approved, it is placed on record, as described later, and is considered a constant, because it never changes until the method of performing the operation is changed.

Two kinds of tasks are used—temporary and permanent. Temporary tasks are set when, for some reason, such as unsatisfactory equipment, non-standard parts, or poor materials, it is not possible to set a task which would be permanently satisfactory to both the employee and the company. Permanent tasks are set in every case where the manufacturing conditions are as near ideal as possible. They are changed only when the method of manufacturing is changed.

The time study department retains all the data in connection with each time study in a permanent file, after posting the task on their master rate card, Fig. 4. This master rate card is a special copy of the master operation card issued by the engineering division covering each symbol. Each production department is furnished by the time study department with departmental rate cards, Fig. 5, covering each operation on each symbol performed in their department on which a task has been set. Inasmuch as all rate records are carried in tasks, changes in class rates are made with no adjustments whatever to the rate records.

Wage Adjustments Without Friction

All discussion with workers in connection with the work they perform is carried on in terms of "task" or "pieces per hour". That is the point on which the success or failure of any wage plan based on production hinges. If you can get and keep the workers thinking in terms of "pieces", the thing that they are actually dealing with, you will have no trouble in getting across changes in tasks, which are absolutely necessary in order to get efficient and economical production. The same thing is true in connection with changes in class rates, which are the variables of the system. You will have very little trouble in selling workers on the necessity of, or fairness in, changing class rates either up or down to keep in step with economic or seasonal changes and conditions. The reason, of course, is that you are talking their language, the thing they come in contact with every day.

No matter what justification you might have for changing rates, if you change piece-work prices per piece, you find dissatisfaction from every corner. The workers can only see that the rate has been cut on their job.

Effect of Plan on Pay-Roll and Cost Computation

In computing the earnings on each job, we have worked out a rate chart, Fig. 6, converting into price

RATE CHART

Day Rate Class—62 Cents Per Hour

Pcs. Per Hour	Rate Per 100 Pcs.	Pcs. Per Hour	Rate Per 100 Pcs.	Pcs. Per Hour	Rate Per 100 Pcs.	Pcs. Per Hour	Rate Per 100 Pcs.	Pcs. Per Hour	Rate Per 100 Pcs.
1	62.000	21	2.952	41	1.512	61	1.016	81	0.765
2	31.000	22	2.818	42	1.476	62	1.000	82	0.756
3	20.667	23	2.696	43	1.442	63	0.984	83	0.747
4	15.500	24	2.583	44	1.409	64	0.969	84	0.738
5	12.400	25	2.480	45	1.378	65	0 954	85	0.729
6	10.333	26	2.385	46	1.348	66	0.939	86	0.721
7	8.857	27	2.296	47	1.319	67	0.925	87	0.713
8	7.750	28	2.214	48	1.292	68	0.912	88	0.705
9	6.889	29	2.138	49	1.265	69	0.899	89	0.697
10	6.200	30	2.067	50	1.240	70	0.886	90	0.689
11	5.636	31	2.000	51	1.216	71	0.873	91	0.681
12	5.167	32	1.938	52	1.192	72	0.861	92	0.674
13	4.769	33	1.879	53	1.170	73	0.849	93	0.667
14	4.429	34	1.823	54	1.148	74	0.838	94	0.660
15	4.133	35	1.771	55	1.127	75	0.827	95	0.653
16	3.875	36	1.722	56	1.107	76	0.816	96	0.646
17	3.647	37	1.676	57	1.088	77	0.805	97	0.639
18	3.444	38	1.632	58	1.069	78	0.795	98	0.633
19	3.263	39	1.590	59	1.051	79	0.785	99	0.626
20	3.100	40	1.550	60	1.033	80	0.775	100	0.620

Class of Work—Screw Machines 1st Class

FIG. 6 RATE CHART FOR DETERMINATION OF EARNINGS

per 100 pieces all probable tasks for each class rate.

The time tickets covering each job showing the task, class rate, and number of pieces produced are extended as to earnings by Burroughs calculator operators in the pay-roll department by reference to the chart to secure the price per 100 pieces and then multiplying by the number of pieces produced, as shown on the time ticket.

Each week every factory executive is furnished with a weekly comparative performance record of each piece-work employee under his supervision.

This plan of wage payment lends itself very readily to economy and efficiency in cost figuring and analysis. With standardized overhead rates, it is not necessary to figure cost on any job performed on a piece-work basis, except when the standard task or the standard overhead is changed. This eliminates, in our case, approximately 75 per cent of the computation of detail costs. It also automatically segregates from the mass the particular jobs or operations which should be analyzed and studied in order to reduce costs. This includes all strictly day-work operations and all piece-work operations which, for some reason, such as new employees, equipment or stock trouble, are done on a day-work basis. By being able to concentrate and study the out-of-the-ordinary, we are able to keep our costs at a minimum.

Packages That Satisfy the Foreigner

Influence on Export Shipping Costs, Deterioration of Product and Selling Appeal

By DIRK P. De YOUNG

THERE is nothing too troublesome for the Quaker Oats Company when it comes to satisfying a customer in any part of the world. Its export business is built upon that principle. Without customer satisfaction all sales effort is futile, and all advertising waste. Cases that carry anywhere, containers indefinitely insuring the retention of freshness and flavor, indestructible labels, lithographed directly on the tins, which neither are nor can be injured by handling, climatic conditions, age, or insects, include only a few of the export packing prescriptions of this well-known enterprise.

"The last word" in the export business, as the Quaker Oats people view it, is "Get the goods to the foreign customer in good condition or get out of the game." And their distribution, it is said, is as complete in Bombay, Durban, or Rio de Janeiro, as it is in New York or Chicago. That is to say, the availability of their product in retail stores is the same from one end of the earth to the other, although naturally its consumption per capita is less in some places outside the United States. It goes everywhere, to the equator, on expeditions up the Amazon, on big game hunting trips into the jungles of Africa, with explorers to the poles, on the ships of both earth and heaven, and with caravans on the backs of camels across the sands of Sahara, Fig. 1. And what is more, when the tins are opened, anywhere, at any time, the contents look as good and taste as good, whenever or wherever opened, as they did the day of manufacture. Tins 20 years old have been opened, after passing through all kinds of climate, disclosing the contents thereof perfectly preserved.

Fig. 1 Ships of the Desert Ready to Cast Off

Those four words—cases that carry anywhere—is all that need be said about packing in the cases for export. Too much has already been written on that subject, practical exporting men think. American consuls since the founding of the Republic have clogged the mails with advice to their compatriots at home on "how to pack for export." Books, many of them, have discoursed at length upon the topic. The files of the Department of Commerce at Washington contain reams of material relating thereto, while writers and lecturers have gone up and down the land exhorting people to pack their cases for export according to Hoyle. That phase of export packing is now well known by even beginners in overseas trade.

But putting goods up in good consumer packages for export is a horse of a different color. To pack a tin of oats, containing 26 ounces of the product, with a 40,000-lb. pressure—the weight of two elephants—without hurting the tin or the oats, is a rather ingenious idea. The Quaker Oats Company export container, which has been designed after years of experimentation, does that and is distinctive in many other ways, Fig. 2. It is of a pleasing color and a work of art only 5¼ in. high and 3½ in. in diameter, making the pressure on it 2000 lb. to the square inch. The contents are packed by means of a geared plunger, gradually and slowly. Rolled oats are very springy, for which reason tremendous pressure in comparatively small space is required. The compression, which must be applied without bulging or disfiguring the container, exhausts the air in the tin, a desirable feature which tends to keep the goods fresh and sweet indefinitely in any climate.

The ideal export container, as well as the domestic one, must carry through to the consumer. It should not only hold up during the transportation period, during which it is handled or manhandled from 15 to 20 times before it reaches its final destination, but it must carry through to the last person—the ultimate buyer—in China, Africa, or South America. It has to hold up regardless of age, climatic conditions or anything else. When it goes into export it may be purchased next week or next year. It may accompany an expedition to the North Pole, or be bought by a band of buccaneers who stock enough to last for a long siege. Sometimes export stocks move slowly. They frequently have to be transported through cold or hot climates, encountering every known weather condition. Thus primarily, oats, which is a semi-perishable product, must be packed in such a way that it will keep almost indefinitely anywhere that men go. That phase of container packing is for the preservation of the product.

The second point is to make an export consumer

FIG. 2 A SUCCESSFUL EXPORT CONTAINER

package of minimum size, for two reasons: First, to get the lowest possible ocean freight rate; secondly, to facilitate transportation, and transportation, remember, is a big word in more ways than one when applied to export shipments. It will nearly always include, for instance, the following operations, and often many more.

The package is loaded into the railroad car at the mills; unloaded into the track warehouse; reloaded into the railroad car; unloaded into the warehouse, New York harbor; reloaded into the lighter; unloaded into the ship; reloaded into the lighter at destination; unloaded on the dock; reloaded on a truck; unloaded into a foreign importer's warehouse; reloaded on a truck; and unloaded at the retailer's shop abroad. That is the minimum number of times the product for export is handled—it is sometimes twice that.

Since Quaker Oats, under the company's world distribution plan, goes into every nook and cranny of the five continents, it is transported on ships, on the backs of donkeys for shipment across the Andes, while negroes carry the cases on their heads in Africa, Fig. 3, and coolies freight them on wheeled vehicles or other primitive contraptions into the interior of China and India. Compression of the contents into small space, therefore, means economy of shipping charges, reduced cost in getting the goods to the consumer, a lower price to the ultimate buyer. Goods of this class pay so much per ton of 40 cu. ft. for the ocean voyage. If the space of a ton, normally packed, can thus be reduced by half, a large saving is effected on the sea journey alone, to say nothing of the saving in all the other handlings mentioned along the way. (See Fig. 4.)

After having settled the important matter of preparing the export package for facility of transportation and cheapness of carrying costs, it has to be made attractive in form and appearance. It is not enough to pack the product snugly and securely like a bullet in a shell and shoot it across the waters to other lands. The label on the package must be distinctive, with colors and designs to make the package unusual on the shelf of the foreign retailer. The company believes in making its tin so distinctive that the consumer will see it at once, while the dealer takes advantage of its superior looks to single it out for special attention, displaying it on counters and in windows.

According to their experience, this method of sales appeal gets results in any country—with the natives of the Orient as well as with the nobility of Europe. The export efforts of the company are not directed to any exclusive class anywhere but to all possible consumers. In China, for example, where there are over 100,000 European residents, the main sales propaganda is directed to the native population.

When these people first began to export oats, they pasted a paper label on the containers. It was very attractive when it left the factory. But its appearance then and its appearance when it got on the shelf of the foreign retailer were vastly different. In a damp or tropical climate the paper label would crumble, become discolored, and fade out like old posters on a billboard. The tins rusted, and the container gave the impres-

FIG. 3 METHOD USED TO TRANSPORT QUAKER OATS IN ZULULAND

sion that the goods were old stuff. To offset that, they began to lithograph the labeling on the containers, which has been found satisfactory and is still in use in export merchandising.

The label on an export package is more important than on the domestic one. The use here of popular breakfast cereals for so long almost that the memory of man runs not to the contrary may cause us to conclude that labels are only put on packages to comply with the pure-food laws. But the Quaker Oats Company, and such firms as H. J. Heinz Company, who export 57 varieties of pickles and relishes, and Libby, McNeill and Libby, who export a humble dish known as corned beef and cabbage in the dress of a Beau Brummel, have got the right slant on this subject.

FIG. 4 COMPARATIVE PICTURE OF RESULTS OF PACKING UNDER HIGH PRESSURE
(Note relative sizes of containers)

The ideal export label, as Mr. Moran, New York export manager of the Quaker Oats Company, says, should tell the world what is inside the tin, what it is for, and give general directions as to how it should be used by the consumer. The people of the United States, as a whole, may be as familiar with the product as with the rising and setting of the sun, but the new consumer—the native of Zululand or Zanzibar—has to be educated to its uses. For that purpose the label should be the instructor. Actual tests by this firm with poor labels and good ones in certain foreign markets have proved this point to the complete satisfaction of the export staff. A multiplicity of tins with different labels for most of the 92 countries of the world, printed in about 57 varieties of languages, is the solution to this angle of the export problem.

To those who are unfamiliar with the practices of some of our most successful exporters, the pains taken to meet the exacting conditions of foreign trade are scarcely comprehensible. As said before "cases that carry anywhere," which the carpenter at the factory builds, about which volumes have been written by experts in foreign trade, covers the "case" part of export packing. The infinite detail of preparing consumer packages, however, of which virtually nothing so far has been written, is appreciated and understood only by a hardboiled few, such as the export experts of the Wrigleys, the Heinzes, and a few others, who have been accumulating this knowledge from an abundance of experience in cultivating export markets on a large scale. More practical knowledge of that nature reposes in the heads of these few men than can be found in all the books of the professors who write about the gentle art of selling American goods on the seven seas in more than seven different languages.

Indeed, so much has been written about export trade in the last decade, by these so-called experts in export advertising, selling, shipping, packing in the cases, and all other angles or triangles of the business that it will take a long, long time for the practical mortals of earth, who test out most of these theories with hard-earned cash, to catch

FIG. 5 AN EXHIBIT USED TO FAMILIARIZE PROSPECTIVE CUSTOMERS WITH PRODUCT AND CONTAINER

up with them. There is, as we all know, excluding such writers and preachers as myself, a vast difference between "how to do things" and "how things have been done," while, according to the old saw, it is easier, and often more profitable, to give advice than to follow it. It is, therefore, unlikely that what the Quaker Oats Company, the H. J. Heinz Company, or any other company has done in detail could be profitably copied literally by anyone else. Relating such experiences serves but one purpose, which is to illustrate the point that, for every export problem, there is a solution for the concern which seriously undertakes it, while the rewards for solving the problems of foreign trade are as great, if not greater, than for similar efforts in the domestic field.

Thus the language difficulties in the preparation of export labels would discourage more timid souls than those who embark, with goods, not with talk, upon the ocean highway of trade. The "Polyglot" tin of the Quaker Oats Company, by way of illustration, has all of its label directions lithographed thereon in four different languages—English, French, Portuguese, and Spanish. For distribution in South and Central America, and the continent of Europe, as well as elsewhere, any one of those languages will suffice. Then, for other divisions or particular countries, tins have labels with other languages. The one which goes to the Levant, for instance, is printed in English, French, Turkish, and Arabic; for Singapore and the Dutch East Indies, in English, Dutch, Romanized Malay, and Siamese; while for India, where there are not far from 200 dialects, 12 of them are printed on the tins. For distribution in China and Japan, Chinese or Japanese alone goes on the packages.

Consider the complex task of preparing labels for export with all the tongues of Babylon appearing thereon! But even that is not all there is to it. This great multiplicity of tins, with suitable languages lithographed on them, have to be carried in stock at the factory, empty, to meet any demand, and again, filled, ready to travel at a moment's notice through the air or over the seas. This commodity is stocked in Patagonia, in Alaska, in any community in the world, and the flow of supply from the factory to the consumer glides ever onward like a river on its course to the ocean. But that trouble means nothing to them. The officials of the company go to any trouble to get results. That is a part of the export business. The exporter who does not wish to go to the trouble of working out these details, and many more, to satisfy foreign customers, need not look for either honors or material rewards in international trade.

Let me repeat, the ideal container for export trade, and many of these points may be of value in the domestic field as well, for purposes of approach, should be distinctive in every way. It should be of a pleasing color and design. The Quaker Oats export tin has a patent top which, when filled, causes it to be hermatically sealed, but which can be removed by the consumer by means of a couple of ears bent down over the lid, Fig. 6. The product should not only keep well until the tin is opened anytime, anywhere, but should also keep well in the same container after it is opened, excluding dampness, bugs, and other sorts of contamination from the contents. Moreover, since nothing is wasted—outside of the United States—the empty tin should be available for household use when the product originally contained therein is gone. Speaking generally, the empty tin should have a re-sale value in such countries as the Far East.

FIG. 6 ILLUSTRATIONS USED TO SHOW FOREIGN CUSTOMERS HOW TO OPEN CONTAINER

Again, this may seem like too much trouble. But, according to the practicing doctors in export trade, who all agree in this case, it helps to popularize the product abroad, thus automatically increasing sales. As Jacob labored 14 years for the hand of Rachel, so the officials of the company labored almost that long to invent a cover for their export tin which would stay on under such pressure — 40,000 lb. But, like Jacob again, their heart was in the business and the labors of love are richly rewarded.

From all of this it should not be concluded, however, that packing good goods in good packages is all there is to it in the export field. That is only one angle of the many-sided efforts of the company to distribute its breakfast food from Hakodate to Halifax. The container, alone, will not sell itself. The more perfect the package, the better it goes, but it takes a full line of other sales propaganda, too, to put things across the waters in a big way. The export advertising appropriation of this concern, which, as Kipling would say, is another story, is large and spent with equal pains. The export policy of the company is liberal, but the procedure from the carpenter at the factory who builds the cases "which carry anywhere" to the staff of advertising and sales experts who prepare the foreign copy and design the export packages is as cautious as that of a cat in pursuit of a mouse.

Constant study and careful investigation are the prices to be paid for success in the exporting business, but the rewards are ample to those who earn success by their persevering and intelligent efforts.

A New Graphical Solution

For Time Allowances in Task Setting

By CARL G. BARTH

Consulting Engineer

IN his "Time Studies as a Basis for Rate Setting,"[1] Dwight V. Merrick gives a percentage allowance formula developed by the writer from numerous experience data furnished by the former, together with a set of curves for the graphical solution of the formula.

Since developing this formula, I have often wondered why I did not at the time make a set of curves representing directly the final task times, to which the curves representing the formula are only an intermediate step. In fact, more than three years ago I spent some time in a vain attempt to do this to my satisfaction, and it is only now, when I have been at liberty to devote a great deal of time to the problem, that I am able to present the results of my efforts in a diagram worth bringing to the attention of the time-study profession and others interested.

When substituting the letter h for T, my formula as given by Mr. Merrick is

$$(1) \qquad P = 20 + \frac{49.5 - 0.326\,C}{\sqrt{0.376 - 0.0000216\,C^2 + h}}$$

in which

h = Estimated (Mr. Merrick calls it selected) minimum time-study handling time for an entire cycle of operations on a job.

C = The percentage that h is of the entire cycle of operations.

P = The percentage by which h is to be increased (the allowance percentage) to become the handling portion of the total task time for the entire cycle.

This augmented handling time will hereafter be designated by H.

It will readily be seen that this can be expressed from formula (1) as

$$(2) \qquad H = h\left(1.2 + \frac{0.495 - 0.00326\,C}{\sqrt{0.376 - 0.0000216\,C^2 + h}}\right)$$

Theoretically the problem was simple enough, consisting merely in calculating the values of H corresponding to a series of values of C and h, and then plotting these on either logarithmic or ordinary cross-section paper, or on a combination of the two. Unfortunately, however, in all such plots the curves representing the selected values of C get so crowded for small values of h as to make interpolation very difficult and uncertain, so that my efforts had to be directed toward finding some other graphical way of solving formula (2).

The accompanying diagram, Fig. 1, represents my final solution, and is, I think, a satisfactory one, though theoretically it is not absolutely correct except for the values 0 and 100 of C.

I can guarantee, however, that the values obtained for H anywhere in the field of the diagram will be as satisfactory as corresponding values laboriously calculated by the formula itself, and most frequently closer to these than can be obtained by the use of the curves originally published in the book by Mr. Merrick.

It must be borne in mind that there is only the most meager theoretical backing for the results obtained by the formula, which merely represent an averaging up of numerous, often quite inconsistent, data obtained by Mr. Merrick in his practice in a limited industrial field.

However, until something more satisfactory appears, it is certainly desirable to have a handy graphical method of solving the formula as accurately as possible, though undoubtedly my personal interest in the matter has principally been the solution of a mathematical problem as such only.

Turning now to the diagram, its main feature appears to be four logarithmic scales. However, only the two external ones, both marked "Task Handling Time $= H$," are true logarithmic scales, while the two internal scales, marked "Estimated Minimum Handling Time $= h$," are not constructed as true logarithmic scales.

The use of the diagram is illustrated by the example

$$h = 0.9,\ C = 50\%,\ H = ? = 1.35 \text{ Ans.}$$

obtained by laying a straight-edge (preferably a straight line made on a thin strip of celluloid) through the point of intersection of the slant line connecting the reading 0.9 on both h scales with the 50-per cent C line so that it will give equal readings on the two H scales, in this case 1.35, as indicated by the broken line and the little circle. When h has a value between such as are connected by slant lines, the proper point on the C line involved may be obtained either by using a straight-edge to connect the two readings of h, or merely by eye interpolation.

[1] See also "Management's Handbook," pages 824-826.

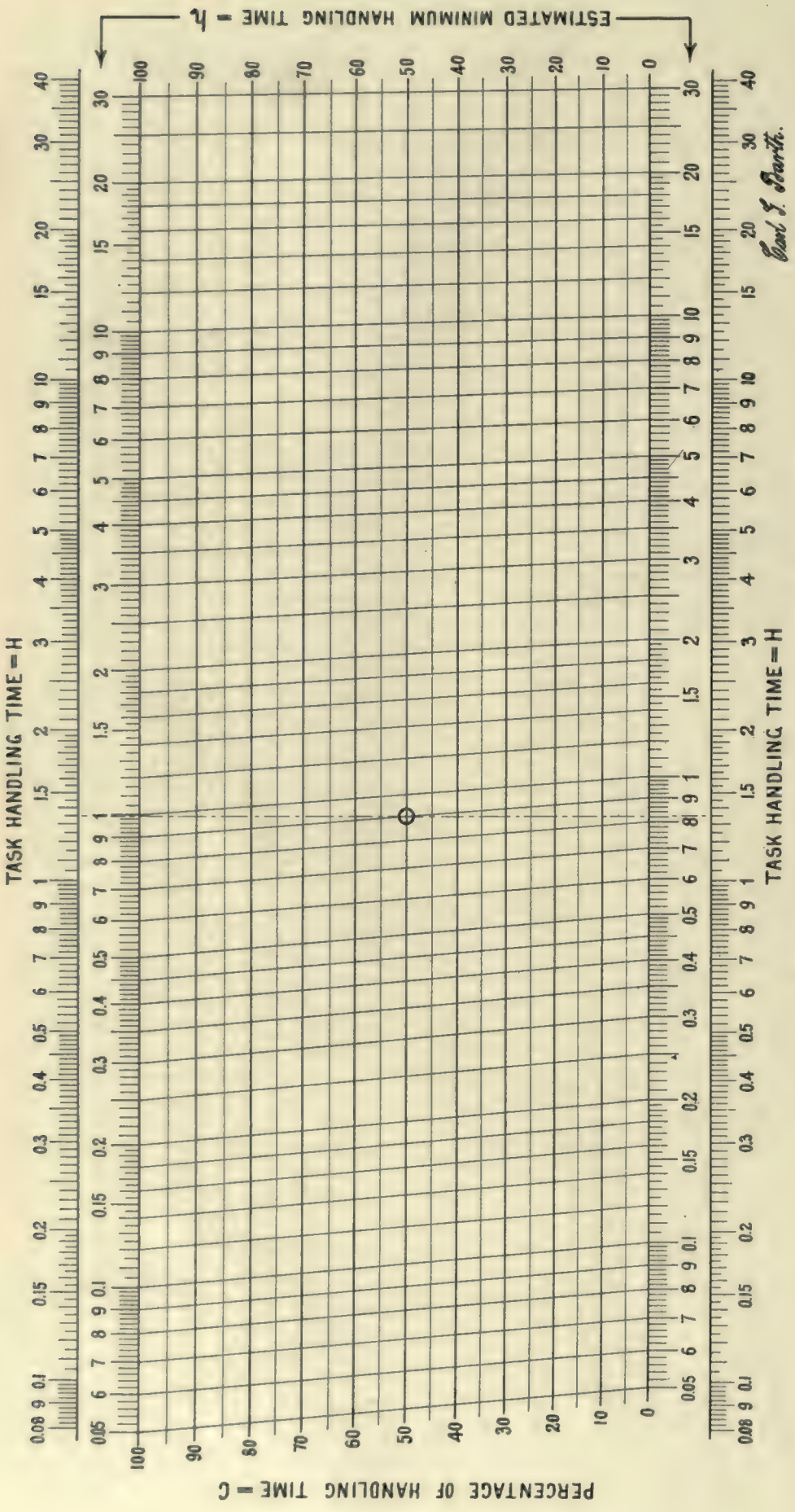

FIG. 1 GRAPHICAL SOLUTION FOR TIME ALLOWANCES IN TASK SETTING

The Use of Interest in Figuring Production Cost*

By J. P. JORDAN

The Stevenson Corporation, G. Charter Harrison, J. P. Jordan and Associates

THE question of whether or not interest as a whole, or interest actually paid out versus interest not actually paid out, should be treated as a cost in manufacturing is one which can be discussed only by careful analysis.

Without doubt, a positive error is continually being made in failing to lay aside legal, banking, and all other such arguments, and in neglecting to dissect carefully the problem into its factors, and thereby determine clearly just what effect each factor has on the business.

For example, the question as to whether a sales department is so weak-minded as to be unable to get high enough prices for the product unless interest is included in cost is in itself ridiculous and has no place in the argument. But if the sales department is selling a product manufactured on a high-priced machine at a low cost, against a similar product manufactured by a competitor by hand, a selling price which does not include a consideration of interest on the expensive equipment would be wrong and a piece of very bad business.

This discussion, therefore, is devoted to an analysis of the various kinds of interest, their effect on business, and their treatment as indicated by the necessities in each case.

The basic position in this analysis is from the standpoint of establishments in some one industry. A packing house competes only with other packing houses; therefore, all have the same general characteristics, and it is unnecessary to consider packing houses versus cotton spinning mills.

The principal kinds of interest commonly encountered are:

Interest actually paid out:

1. Interest paid on bank loans
2. Interest paid on notes to creditors
3. Interest paid on open accounts owed
4. Interest on bonded indebtedness

Interest not actually paid out:

5. Interest on buildings and real estate
6. Interest on machinery
7. Interest on fixtures
8. Interest on raw materials in stock
9. Interest on materials, labor and burden in process
10. Interest on finished goods
11. Interest on cash on hand
12. Interest on accounts receivable
13. Interest on other miscellaneous assets

The items listed above will be taken up and discussed in order.

Interest Actually Paid Out

Items 1 to 4, inclusive, cover interest actually paid out on liabilities. As the complete asset side of the balance sheet is considered in this discussion, the interest paid out is immediately disposed of as a debit to profit and loss. It is manifestly impossible to do otherwise when consideration is given to the question of charging into cost the interest on the various items of investment shown on the assets section of the balance sheet.

Interest Not Actually Paid Out

5. *Interest on Buildings and Real Estate.* A very tangible argument exists for charging interest on buildings and real estate to costs. Within a given industry are concerns which own their own plants and those which do not. Assuming that each is obliged to defray repair costs, the one owning its plant will be found to include in costs:

Depreciation on buildings
Taxes on buildings and real estate

The one not owning its plant will charge to costs its complete rent, which includes the two items above plus interest to the owner of the property; in other words:

Depreciation
Taxes on buildings and real estate
Interest on the value of investment

If these conditions prevail, it is evident that the company owning its plant will constantly have a smaller cost by the amount of the interest received by the owner of the property for which the other company pays rent, and to that extent will lose money in prices which are set on cost. It would, therefore, seem beyond doubt that this kind of interest should be included in cost.

6. *Interest on Machinery.* The failure to include interest on machinery in the cost of production may often result in very misleading cost figures. A manufacturing establishment that is progressive is con-

* Condensed from a chapter of the forthcoming revised edition of "Cost Accounting Principles and Practice."

stantly installing new, rapid, and up-to-date machinery. A printer installs high-speed presses; a founder jarring machines; a chemical plant centrifugal machines and vacuum dryers; a machine shop designs special tools, rigs and machines, and installs automatics. Such equipment costs large sums of money, and replaces, in recorded capital value, a much larger intangible capital value of hand labor.

Obviously, there immediately arises the possibility of figuring costs which would fail to consider the offset of interest to the saving of labor, unless interest on the high investment is brought into the cost. It must be conceded, therefore, that the safest course is to bring interest on machinery into the manufacturing cost.

The records of the company show the machinery investment for each department as the basis for depreciation charges. This same investment value—original investment, not considering any deductions for depreciation—becomes the amount of capital value on which to charge interest.

Without discussion of the whys and wherefores of what rate to charge, 6 per cent is a quite usual rate to consider, although any rate desired may be used.

7. *Interest on Fixtures.* Assuming that all labor-saving devices, producing machines, and all kinds of material-handling devices are included in "machinery," the item of fixtures becomes reduced to inert items wherein one company has no advantage over another. Therefore, it would seem that interest on such items has no grounds for consideration as a part of manufacturing costs.

Raw Materials

8. *Interest on Raw Materials.* All plants within one industry are on approximately the same plane of raw material stocks, with one exception. This exception has no concern for the individual business or the industry, but is purely a business gamble and, as such, should have special treatment.

Normal raw material stocks have no special or other than normal effect on the costs of the business, which is the reverse of the case with special and expensive machines. That is, every plant within a specific industry is on the same plane. Therefore, there is no advantage to be gained in the charging of interest on normal stocks to cost.

If, on the contrary, a company which has the necessary credit or cash buys raw material far ahead of normal requirements, pays for them and holds them in warehouses on the argument of "beating the market," it is obvious that the excess material over normal requirements should be penalized with a charge for interest in order to reflect properly the result of the judgment used in making the purchases. Otherwise, the real truth would never be known.

In such cases, the excess material should be entered on a special stock record sheet, a transfer of a month's supply being made from the excess stock to the regular stock as the normal supply period (say 30 or 60 days ahead of manufacturing requirements) is reached. At the time this transfer is made, an interest charge is added to the original invoice cost for the elapsed time at, say, 6 per cent. This charge is debited to the Raw Material account and credited to Interest Charged to Cost.

An example follows: A rubber tire factory requires for normal monthly production 500 tons of crude rubber. A normal inward flow on contracts may be maintained, but the following takes place: The officials believe that the price of rubber is going up. They accordingly buy heavily of spot and other rubber to the extent of 10 months' excess requirements, and take it all in. They make no future contracts, as the prices for future contracts are higher than the prices they paid. They had on hand two months' (normal) supply when the large quantity was bought.

Normal inventory on hand, 1000 tons at 22c per lb.	$440,000
Excess purchases covering 10 months, 5000 tons at 22c per lb.	$2,200,000

This 5000 tons is taken in and a special stock record sheet is set up. At the end of one month, a month's normal supply of 500 tons is transferred to the regular supply stock record sheet. It will be charged with one month's interest on 500 tons at $0.22 per lb., or $1100, a journal entry debiting Rubber account, and crediting Interest Charged to Cost being made. The 500 tons when entered on the regular rubber stock sheet, will be at the pound price of $0.2211, instead of at $0.22 per lb., the original invoice cost.

The next and each succeeding month will require the same entry, except that the interest is for one additional month each time. In other words, the cost per pound for each transfer will run as follows:

Month	Transfer Price Per Pound	Month	Transfer Price Per Pound
1st	$0.2211	6th	$0.2266
2nd	0.2222	7th	0.2277
3rd	0.2233	8th	0.2288
4th	0.2244	9th	0.2299
5th	0.2255	10th	0.2310

The total interest at 6 per cent on the entire transaction would be $60,500 for the 10 months.

By this method, the cost for use of the money for the excess purchase is placed against the material, where it belongs, and the management has an actual record of how the judgment used in the purchase turned out, as compared to what rubber could have been bought for during this period. Should the company charge the rubber to cost of production at market each month, and make use of a Rubber Adjustment account, a most complete record of purchasing efficiency is obtained.

To summarize, there seems to be no justification to attempt to charge to cost any interest on normal stocks of raw materials, as all companies within an industry are on a like plane. On the contrary, there seems a very good reason to charge interest on excess purchases.

This reasoning should not be applied to small items where monthly requirements are so small that the purchase of a year's supply is only a convenience, and no features of economy are involved.

Work in Process

9. *Interest on Materials, Labor and Burden in Process.* A very good argument has been brought forward, that work which is in process for a long period of time should bear a penalty of interest in order that the final cost should reflect the cost of the excessive use of money. Theoretically, no one can disagree with this argument. In actual practice, however, there are two very good reasons for not considering this interest as a part of cost. These reasons are:

1. It is a most impracticable practice to carry to a logical conclusion.
2. In the last analysis, there is no particular practical need for considering it.

In respect to the first point, it may be that some products lend themselves to a fairly easy method of figuring interest on the investment of material, labor and burden for the time the goods are in process. Hams in a packing plant are in process for a well-determined period, and it would be fairly simple to compute an interest charge. Certain products which require a period of aging may also be easily charged with interest, and, without doubt, should be. But on this particular point, is such process of aging to be regarded as an actual *manufacturing process?* It would seem not. At the same time, while lumber sawed and piled may close the actual manufacturing cycle, there is the year or two required to air-dry properly, which absolutely demands the interest charge if its correct final cost is not a manufacturing cost, as it is ordinarily regarded. Interest is a *carrying cost,* and such carrying cost applies in many cases.

A heavy machine shop, manufacturing large apparatus, gives a very good example of the impracticability of charging interest to cost from the standpoint of penalizing long-term orders as against short-term orders. A large pump, for instance, may be in process for months or even a year. A few parts go into process at the start and a few additional parts every day or two for a long period. To penalize properly this pump with interest on the material, labor and burden involved would require an exhaustive tabulation of when each part went into process, and the dates of the expenditure for labor, with its burden. How else could an interest charge anywhere nearly accurate be figured? It is obvious, without further discussion, that this is entirely impracticable.

It is thus quite apparent that, to be of any use along the line of penalizing long-term products as against short-term products, the charging of interest is impossible of accomplishment with any degree of economy.

As to the second point, that in the last analysis there seems to be no particular need for considering interest on work in process, let us consider the facts.

Aside from negligent shop management, the large pump previously referred to would be in process for a long time, no matter who manufactured it. That is, every heavy machine shop has the same condition—orders which are a long time in process. As this is so, where does the necessity exist for adding the interest in the cost? If every shop in the industry is in just the same position in respect to such work, wherein is the need to safeguard competitive bidding by including interest?

In the packing industry, hams take approximately the same time for production in all plants. So, at least as between different plants, there is no need for interest to be considered. If, however, it is desired to penalize hams which are a long time in process as against fresh meats which are disposed of quickly, we have a different proposition. Admittedly, there is some justification for charging interest to a product which takes 60 or 90 days to complete, particularly when practically all other products go through and are shipped quickly, and where the product in question is of unit nature and subject to speculation or rapid variations in price. In such cases, the allocation is simple, as, the value and time being known, it is easy to figure the interest, charging it to the product and crediting it to Interest Charged to Cost.

In general, however, it is almost an impossibility to see any benefit from charging interest on work in process, as in the same industry all plants are on the same plane. A fly-wheel casting that takes two weeks to cool in one foundry will probably take two weeks to cool in any other foundry. Therefore, each has the same condition, and interest is unnecessary in so far as this condition is concerned.

Finished Goods

10. *Interest on Finished Goods.* Here again it is necessary to differentiate carefully as to just what is meant. Lumber, sawed and piled, is green and unsalable until dry. This drying stage is neither a manufacturing process, nor is it related to finished stock. It is an aging or drying process, and most certainly interest should be charged for the elapsed time of aging on the value of the product as it left the mill.

When dry and ready for sale, this product becomes *finished stock.* This same reasoning applies to any material which requires an aging, drying or curing period.

In well-ordered businesses, the normal finished stock carried is that which the nature of the business requires. If the company is properly managed, the finished stock is kept to a point of normality by the manufacturing schedules.

As stocks of finished goods are practically a *constant* in every individual business within one industry, there is nothing to be gained by charging interest on this stock, as all units within one industry are on the same plane.

11. *Interest on Cash on Hand.* 12. *Interest on Accounts Receivable.* 13. *Interest on Assets Not Specified.* Within the same industry, these three items are constant in the main, as the terms of sale and other conditions are similar. Therefore, from the standpoint of competition within the same industry, there seems no necessity for considering interest.

A good example of such similarity may be found in businesses which follow the custom of "future dating" of invoices. When a product is seasonable, it is often customary to have customers accept goods which are billed with due date perhaps four months distant. This apparent inflation of accounts receivable is in fact to permit a more balanced plant operation, and it so results. As this is the usual custom of any industry which is seasonable, the entire industry is on the same basis, and no consideration need be given to charging interest to cost of production.

Summary of Recommendations

Interest charged to cost is recommended as the proper accounting procedure in handling the following cases:

On Buildings and Real Estate, in order to equalize the property occupancy cost with competitors who pay rent.
On Machinery, as nearly every plant has special or high-priced machinery for labor-saving purposes, and it is necessary to include interest to arrive at the real cost.
On Raw Materials which are bought beyond requirements, and which should be penalized with carrying charges in order to know their exact cost when included with current stock.
On Product going through an aging, curing or drying period. This is a carrying charge rather than an item of manufacturing cost.

Interest charged to cost is not recommended in the following cases:

On Fixtures, as there rarely are any fixtures which affect costs.
On Work in Process, as all companies within one industry are under like circumstances. Also, it is almost entirely impracticable except in a few cases of individual products, such as hams in a packing plant.
On Cash on Hand, Accounts Receivable, or any other assets other than as already referred to, as such items are constant within the same industry, and, therefore, require no special interest consideration.

Interest as a whole is impossible of discussion. Interest in explicit cases and on various phases of the business may be dealt with clearly and with profit. Perhaps a good rule to follow is: Where interest is obviously an important consideration in an individual situation, *use it;* where interest has no apparent value for the safeguarding of the accuracy of costs for competitive purposes, *disregard it.*

Universal Tow-Bar for Automobiles

A RELIABLE, flexible tow-bar for towing trucks or passenger automobiles is heartily appreciated by manufacturers of cars and all those who have to handle a car not under its own power. One design which possesses features that make it particularly handy and effective is shown in Fig. 1 attached to the front axle of a light car.

It is built on the principle of a universal joint and is spoken of as a "one man" type of bar. It can be attached to any car in from 5 to 7 min. and effects a saving of one man. Such a bar is far superior to a rope in every respect. It eliminates practically all of the jerk which, when a rope is used, a towed automobile exerts on the car pulling it, due to starting and stopping and to the inequalities of the road.

This means a saving in wear and tear on the towed car, but principally on the car doing the pulling, where the fluctuations of tractive effort are reflected in the frame and in all parts of the mechanism.

Towed Car Follows Path Closely

A particularly desirable feature is the way in which the tow-bar makes the rear car follow the path of the front one. This close keeping to the track exists not merely on a straight run, but also when going around curves or turning corners. Extensive experiments have demonstrated that the towed car will roll to within one inch of the track of the towing car on both straightway and curved paths of travel.

The Chevrolet Motor Car Company employs this type of tow-bar to take automobiles from the Oakland plant of the company to the docks on the waterfront. It is extensively used in and around San Francisco by motor car agencies to tow new cars from the railroad depots to the showrooms. Besides being in the manufacturing and distribution of automobiles, the tow-bar, of course, finds extensive applications among the various local garages and service stations in cases where cars break down on the road and must be taken to some repair shop before they can be replaced in service.

The tow-bar is one of a series of automobile devices which are the inventions of Sid Kimmerle.

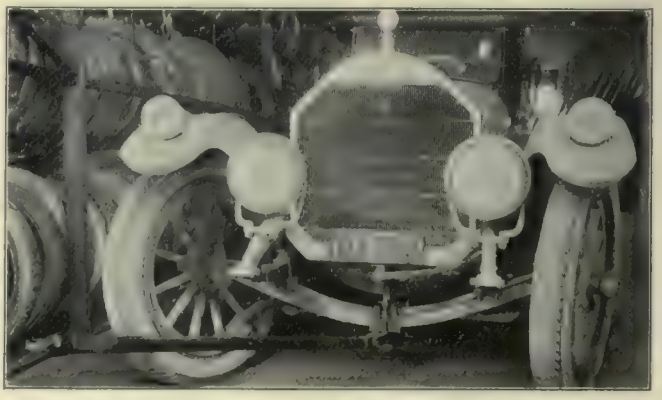

FIG. 1 UNIVERSAL TOW-BAR ATTACHED TO CAR

Profit-Making Factory Equipment

Work of the Industrial Executive

By B. A. FRANKLIN

Vice-President, Strathmore Paper Company

IN this age of invention, machinery has become the most common thing in industry.[1] Once possessed, its very solidity and dependability become a danger. It is the first and most important item that receives real attention when the establishment of the industrial unit is considered, because it is the first essential without which existence is impossible. Once obtained and set to work, it becomes not infrequently the last consideration.

This is, of course, human nature. The industrial executive buys the best machinery and equipment that, at the time of need, he thinks he can afford. It appears solid, controllable, fixed, long-lived, and expensive. It has solved the main question of production, and, presumably, with comparative permanence. The usual, ordinary, and the simplest thing to do is to get the best results possible from it, and to continue that course more or less indefinitely over a long period of time. If, perchance, the pressure of daily problems occasionally relaxes sufficiently to permit consideration of these permanences, the cost of change or replacement frequently seems so great as to sidetrack action.

The output of machine equipment naturally will be lower in price or higher in quality than that of the hand labor it displaces. It must, however, go further than this—it must match or excel the output of competing machines. Mr. Franklin, writing from this point of view, emphasizes the insidious dangers of poor condition or obsolescence in machine equipment and presents a formula for determining when lower output or obsolescence demands a replacement of any particular machine.

The truth of the matter is that the possession of machinery produces an insidious effect. The human mind likes to see it work. The executive mind desires to see it produce, to earn on its investment; hates to see it discarded as long as it is able to do what it was originally designed to do; feels that to replace it before replacement was expected, or before it has outlived its usefulness, is to waste its investment.

As a result, especially in the older industrial centers, there are many manufacturing units, operating casually with ancient outfits, unable to meet the competition of newer districts or of newer units, struggling along without growth because of high costs and restricted profits, or frequently with no profits. The writer has in mind two plants, recently fallen into new hands, once profitable and reputable, still reasonably solvent but, despite the introduction of modern methods, struggling against the handicap of old machinery and equipment. Eventually they will be forced to choose between rehabilitation or cessation. And these two plants are representative, at least in degree, of very many industrial units.

The Machine-Hour Measure

No industrial executive can afford to revamp his machinery and equipment at will, and it would be often a ruinous process if he did. But there is a formula, the constant operation of which ought to be a part of industrial unit practice.

Machinery and equipment, especially the former, wear out, but the results of wear and tear can be so largely offset by care, repair, and replacement as to be economically distributed over a long period. The greatest destroyer of the comparative value and efficiency of machinery is obsolescence—the result of the invention of new machinery which will accomplish much greater volume in a given period of operation.

In this advancing age of machinery, in the last analysis, the vital problem of production is not always, nor indeed mostly, so much what can be obtained per man-hour, as what can be obtained per machine-hour, since that is the limiting factor of the operator, and may largely reduce the product the operator is capable of making. As to equipment, the output of the combination of machine and operator depends not a little on the equipment supplied.

If to these considerations is added the fact that the tendencies, both of competition and the buyers' demand, are for lower prices, it will be evident that the question of machinery and equipment is a constant and extremely important one in the profitable life of the industrial unit.

In the modern and advancing competition, the maximum production he can obtain per machine-hour from the machines he has is a vital matter to the industrial executive. It is his internal daily problem. But he must be alert to discover what the machine-hour production would be if he possessed the latest machinery designed for the work—machinery which is or will be possessed by some of his competitors. This is his external problem. It demands that he keep in

[1] For preceding articles see MANAGEMENT AND ADMINISTRATION for September 1924, p. 249; October 1924, p. 391; November 1924, p. 513; December 1924, p. 611; January 1925, p. 21.

touch with his machinery market, which is no difficult problem, for, with very little encouragement, this market will camp on his doorstep.

Maximum Machine-Hour Production

To solve his internal problem, the industrial executive can, with the aid of his cost system, work up his own formula. In working up this formula, the executive has two aids: The first is the fact that the cost per machine-hour involves, not only the labor cost, but the expense rate per machine-hour, and it most frequently happens that the latter is the larger item of the two. Through a proper cost system it is not difficult to figure what an annual saving would amount to in reduction of the total cost of the operation with the latest designed machine. With this saving in mind, and the net cost of replacement, decision may rest on the calculation as to how long the saving must operate to replace the added investment and begin to turn back to profits its whole amount or otherwise to place the unit on a stronger competitive basis. Certainly, machinery must from time to time be replaced. Such a formula, constantly considered, is the scientific basis, as well as the common-sense basis for its replacement.

The second aid in the solution of this problem lies in depreciation. The wise executive appreciates the necessity from the accounting point of view of a proper allowance for depreciation, both from wear and tear, and from obsolescence. The tax laws recognize these depreciations of value. Too often, however, depreciation is considered as merely an accounting gesture. Yet depreciation from the common-sense, business point of view ought not merely be set up on the books as a reserve to cover the definite losses which occur, and to ameliorate taxation, but also to be put into the actual cost of manufacture so as to make a complete basis of cost for price-fixing. This must be done in order to obtain the return of this loss.

Depreciation has, however, a more important function. It is a definite calculation of the amount of waste of capital invested, and the main purpose of setting it aside is to create a reserve to be spent in new machinery to replace the calculated waste. In practice, therefore, depreciation reserve is the pool into which the executive dips to obtain funds withheld actually from the sale of production, to keep his investment in machinery and equipment up to its true normal value and efficiency. Otherwise depreciation has no effective operation.

A Formula for Machine Replacement

With this depreciation in mind, the formula for machinery replacement becomes still more effective from the possible and practical point of view. Its proper operation in the past, with common sense and judgment, would place many industrial units today in a much happier operating and profit-making condition. Its proper operation in the future, with both foreign and newer locality competition, will be the salvation of older industrial localities. Its operation is entirely in the line of scientific management.

Such a formula might be stated mathematically as follows:

$$\frac{\left(\begin{array}{c}\text{Cost of}\\ \text{new machine}\end{array}\right) - \left(\begin{array}{c}\text{Salvage of}\\ \text{old machine}\end{array}\right) - \left(\begin{array}{c}\text{Accumulated depreciation}\\ \text{on old machine}\end{array}\right)}{\left[\frac{\left(\begin{array}{c}\text{Hourly cost of}\\ \text{old machine}^2\end{array}\right)}{\left(\begin{array}{c}\text{Hourly production}\\ \text{of old machine}\end{array}\right)} - \frac{\left(\begin{array}{c}\text{Hourly cost of}\\ \text{new machine}\end{array}\right)}{\left(\begin{array}{c}\text{Hourly production}\\ \text{of new machine}\end{array}\right)}\right] \times \text{Annual production}}$$

= Years required for new machine to return its additional investment

In a given case, the problem might work out as follows:

$$\frac{\$6000 - \$1000 - \$3000}{\left(\frac{\$0.80 + 2.20}{12} - \frac{\$0.80 + 2.50}{20}\right) \times 25{,}000} = \frac{\$2000}{\$2125} = \begin{array}{l}\text{Something less than one year, or, with a correction for interest, say one year}\end{array}$$

In this formula a higher expense rate is allowed for new machinery.

This may look like a very favorable case, but there are very many cases like it. At any rate, each case so worked out will give the executive a basis for judgment, and in many cases there are still two points of possible further vantage, i. e., a greater annual production to sell, and the putting of the unit on a better competitive basis.

Elements in Lowering Machine Production Cost

When improvements are made in existing machinery to increase production, or the same result is effected through the substitution of newer machinery, or the addition of equipment, then it is the fair thing to change rates and bonuses for production to at least the extent to which the change is responsible, if extra effort of the operator is not created thereby.

Machinery production cost cannot, however, be considered merely as to the single machine, for complete production is almost invariably a matter of group machinery operation. The cost, therefore, of this production, if considered from the economic point of view, as of course it must be, involves two important elements. The first of these is straight-line and continuous production. If the best value is to be obtained from one machine, it is important that the raw or semi-finished material be promptly fed to it and taken away from it. When, therefore, the grouping of machines to bring about finished production is considered, both the questions of readiness of material and transportation become important. A chart of the movement of material in many industrial units frequently presents a picture of tangled threads, involving considerable extra labor cost, whereas, as nearly as possible, a single line should represent this movement of material.

A second most important element involves the equipment of the industrial unit both as to the machines themselves and transportation to, between, and from them. A proper scientific management theory involves the utilization of the most skilled labor to the maximum, aiding it in less skilled work by less skilled labor. A second scientific management theory involves

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[2] Hourly cost of machine is sum of hourly labor and expense costs.

the most economic results with the most helpful equipment. Transportation should be arranged not merely to make it as prompt as possible but most economical and independent of labor cost. Perhaps an outstanding example of such a solution is the Ford method of assembling. Here again a proper cost system may quickly operate with data and calculation to develop a formula, and to show savings to be made by installation of equipment, both to facilitate production and cheapen transportation. When this is done, a proper balance between cost of equipment and its liquidation by savings may be made with consequent decision.

These things are, of course, reasonably well known as to their theory, but their practice is too often left to chance inspiration and suggestion instead of careful and competent survey. There is in mind one case in a well-managed company, where only recently, after a number of years' operation, it was discovered that the introduction of simple, quick handling equipment cut the operation cost in half. There are many such conditions which would develop from a practical understanding or comprehension that, in these days of shorter hours and increasing labor cost, the great need is for labor-saving machinery and equipment.

Maintenance of Machinery

It seems sufficiently obvious that, through the very purpose of machinery and equipment to produce with accuracy and dispatch, there should be instituted in every industrial unit a definite routine of care and cleanliness, of lubrication and watchfulness of bearings and wearing surfaces. Without a routine method and a definite responsibility placed upon a trained man, the usual carelessness of even skilled operators, whose main aim is production, brings about, in time, the condition that machinery operates more slowly and less accurately, thus producing lower quality at higher cost, and it will eventually be found that the effective machine life is shorter. The industrial executive, in the interest of economy and preservation of his investment, should give this point definite consideration and develop a system of trained care and supervision, the cost of which will be found to be well covered in the resulting eventual economy.

Especially should such a system take into account the question of repair. It very often happens that a careful inspection of machinery and equipment will discover repair requirements even before the necessity of shut-down occurs, so that, with such forewarning, repair may be made at noon times or in natural shut-down periods without diminution of production. It will also be discovered frequently that part replacement instead of shop-patch often not only is more economical in the particular repair, but keeps the machinery and equipment in a much more up-to-date condition, and prolongs its natural life; for it must not be forgotten that even with obsolescence there is much machinery that has a very long natural life.

It is also true, especially with large machinery and equipment, that it may often be brought up to the most modern requirements by the addition of newly invented and devised attachments which, without complete replacement, add to its efficiency.

When machinery and equipment are considered as a unit for production, an important problem that presents itself is the balancing of it, i. e., the establishment of the group in such a combination that the flowing production will keep them all busy. This involves a study of all operations and the hourly production of each machine, so that there shall be a sufficient number of the slower ones to keep the speedier ones at maximum production. This, of course, is not always possible, in which case it becomes important so to arrange the combination as to keep busy, if possible, the originating and the expensive machinery. In this problem lies a definite cost reduction factor in many units.

The standardization of the operation of machinery and equipment is a very large factor in its maximum economic use. A machine is designed and built to be operated with certain equipment, at certain speeds, with certain tools, and to produce certain production under best conditions. These necessities and possibilities are often either forgotten in time or are unheeded. Eac hmachine ought to be definitely, and in unity, standardized as to these things, and the cost department furnished with the standard hourly production as a basis for reporting continuous departure from standard, and as a basis for a shop return to them. There is no better method of keeping up the maximum use of machinery definitely bought for a given balanced purpose, but left to a varying and uninformed or careless group, than such a method of standardization of possible and practical use.

In this matter of standardization, of course, there enters the question of toolroom, of tool supply, of spare parts and, especially, of all necessary arrangements to keep the machinery operating to the maximum.

There is, of course, also a valuable standardization, in any one unit, of type of machines and in type of operation. The industrial executive, with the outlook to the future, will of course see that his machinery is of the best type for the purpose, and is operated, whether under the group or on the unit plan, in the most economical manner.

It is, of course, needless to point out that it is both humane and economical to arrange with the utmost care for safety both in the placing of machinery to allow ample room for movement about it, and also for protection against moving parts.

When all machinery is utilized steadily, the power load theoretically ought to be steady, although statistics show that it is not. Where certain intermediary machinery cannot be run full, frequently a study of the daily power loading may show that the intermittently operating machinery may be most economically operated between certain hours, assuming that the proper labor conditions can be met.

Power machinery is, of course, an important element in the operation of any plant, even when the power is bought and not manufactured. The best experience with this element of machinery shows that it pays

definitely to measure its efficiency from all angles, and that a bonus system for the attainment constantly of standard production of power is advantageous.

Place of Machinery in the Industrial Unit

In this modern age of industry, machinery and equipment, with organization, come near to being the most important elements in the industrial unit. Nothing will so insure future success—and the industrial executive must always be concerned with future success—as proper attention to machinery and equipment. While organization may be the key to present success, undoubtedly machinery and its proper consideration are the keys to future success.

The industrial executive who lets his machinery become comparatively inefficient, either through careless operation or unreasonable obsolescence (for even the latest model quickly becomes a little out of date), sets for his industrial unit a definite handicap often not to be overcome by the most efficient labor operation.

The standard gage by which he must measure machinery efficiency is not the physical condition of the machine, important as that is, nor the production from it of approximately 100 per cent of its standard output; but the gage must be the production of the latest and best machine on the market operating in the hands of competitors.

Under these conditions, the industrial executive who desires to keep his unit to the forefront must learn to estimate his production in terms of machine-hour cost and to measure his relative standing in his market by the lowest machine-hour cost producible on the latest machines. While it is true that care and arrangement of his machines, and the fact that his competitors are seldom completely equipped with the latest machinery, will permit him still to compete with profit, this condition cannot be expected to last over a long period, and a definite long-term plan should be made to meet any possible competition.

An industrial unit need not grow old, but its youth and vigor can only be maintained by watchfulness and the common-sense infusion, by calculated plan, of modern machinery and equipment.

An Inexpensive Coat Rack

SOMETIMES it is a problem where to put the cloaks and hats of employees. In shops where there are facilities for purchasing chocolate or foodstuffs during the working hours or recess, employees, especially female employees, want to get at the change in their purses, but want to leave the purses in their cloaks rather than be bothered with them at work. In such cases it is desirable to have the cloaks in the working room both on account of eliminating time lost going to the cloaks, and to have the apparel under the eyes of its owners. Moreover, if the clothing is close by when noon hour comes, the building is emptied in a short time without confusion.

The racks used in the Bauman Clothing Company furnish an inexpensive way of serving these purposes. They are built of pine board against the interior wall which runs along the middle of the building to form a central corridor. Hence they are out of the way of the work, but are between the operatives' benches and the door by which they go out to the elevators, so that employees pass the racks on coming in or going out.

Method of Construction

Through the upright board which forms the sides of the coat rack, holes are bored to take a length of 1-in. galvanized iron water pipe. This forms a long bar on which coat hangers are hung. There is one coat hanger for each employee. Other upright boards divide the racks at intervals into short sections, and each employee's coat belongs in a definite section. This is much the same arrangement as is used in retail clothing stores to conserve space and at the same time have clothing handy to get at.

The pipe bar is run at a distance from the wall sufficient to give the coats plenty of room to swing without touching the wall. Hence, even when they are slightly damp, they do not soil the wall. The floor is cement and in wet weather a little moisture dripping on it does no harm, but can be quickly mopped up by the boy who does the sweeping of the floor.

Above the coat hanging bar two rows of horizontal boards form shelves running the entire length of the rack. These shelves are for the hats of employees and two rows are required on account of the greater horizontal space which hats take as compared with that occupied by coats.

Altogether, this method is very compact, as a great many coats and hats can be put into one section. In addition, it has the advantages of cleanliness, as the rack is open and can be thoroughly scrubbed.

FIG. 1 COAT RACK COMBINING SIMPLICITY AND CONVENIENCE

Money-Saving Material Handling

Data on Conveyors, Cranes, and Hoists

By GEORGE E. HAGEMANN

Associate Editor, MANAGEMENT AND ADMINISTRATION

THE experiences of all industrial plants which have installed material handling equipment point universally to the fact that such installations have been attended with increased economy of operation. Many of these instances have been presented in detail in previous articles.[1] Additional data are listed in the compilation given below.

Pneumatic Conveyors

At the plant of the Milstead Manufacturing Company, a pneumatic conveying system installed by the B. F. Sturtevant Company has produced savings of $1683 a year. This system distributes incoming cotton to the aging room at the rate of 2000 lb. per hr. The process gives more uniform moisture content, makes the cotton fluffy, removes dirt, and enables pickers to remove a bigger percentage of waste material. The result is the production of a better grade of duck from the same cotton or the same grade from a cheaper cotton.

Another system conveys cotton from the opening room to the picker room, a distance of 125 ft., eliminating hand trucking. A further advantage of this system is the reduction of fire hazard by having the opening work done away from the picker room. Details of the savings are presented in Table 1.[2]

At the plant of the Carolina Bagging Company, a Sturtevant system has been installed which carries pieces of bagging weighing as much as 18 lb. This, of course, is a rather heavy weight for a pneumatic conveyor to handle. The first system was installed in 1913 and since then 3 similar systems have been added. They handle an average of 35,000 lb. per 10 hr. day at a cost of $0.413 per thousand—one-third that of other methods—but are capable of handling 50,000 lb.

Two men load the material into hoppers and it is discharged directly alongside of the pickers. This method replaces manual handling and the use of teams and trucks. Another pneumatic conveyor carries material from pickers to the bins in back of the cards, handling 35,000 lb. per day at a cost of $0.09 per thousand.

The net annual savings on the first 4 systems are $7909.20 and the yearly savings on the last conveyor mentioned are $1127.65. The former is a return of 144 per cent annually on the investment and the latter a return of 25 per cent.

An electric hoist installed for the Turner Construction Company, by the American Engineering Company is used to load trucks. This hoist operates under low headroom and saved $1200 in the erection of the building. In addition, savings result from the reduced cost of heating a building with lower ceilings, as well as from the economies of handling materials by mechanical means instead of by manual.

The Reliance Electric and Engineering Company use two 2-ton cranes in their machine shop and a 3-ton crane in the testing and shipping room, the cranes having been manufactured by the Euclid Crane and Hoist Company. The 2-ton cranes in the machine shop have increased production 8 per cent. Each man handles his own work, on and off of his machine by means of the cranes. Formerly chain block hoists were used and an extra man was required to assist the machine operators with the handling. Beside the extra cost, hand hoists proved too slow as plant production increased and the need for greater daily output arose.

TABLE 1. B. F. STURTEVANT PNEUMATIC CONVEYOR DATA
Milstead Manufacturing Company

OPERATING COST OF COTTON BLOWING SYSTEM	
Depreciation—$1,000 ÷ 20 yrs. life	$ 50.00
[1] Average interest at 6 per cent— $\frac{21}{20} \times \frac{\$1,000 \times 0.06}{2}$	31.50
Allowance for repairs and maintenance	25.00
Power—19,200 kw. hr. @ $0.0125	240.00
Labor—1 man @ $2.00 per day × 300 days	600.00
Total cost per year—blowing system only	$ 946.50
Rent on 3 aging rooms—2,250 sq. ft. @ $0.20	450.00
Total cost per year	$1,396.50
Cost per day—$1,396.50 ÷ 300 days	$ 4.66
Cost per bale—$4.66 ÷ 32 bales	$ 0.146
OPERATING COST OF COTTON CONVEYING SYSTEM	
Depreciation—$500 ÷ 20 yrs. life	$ 25.00
[1] Average interest at 6 per cent— $\frac{21}{20} \times \frac{\$500 \times 0.06}{2}$	15.75
Allowance for repairs and maintenance	15.00
Power—24,000 kw. hr. @ $0.0125	300.00
Labor—1 man @ $2.00 per day × 300 days	600.00
Total cost per year	$ 955.75
Cost per day—$955.75 ÷ 300 days	$ 3.19
Cost per bale—$3.19 ÷ 32 bales	$ 0.100
SAVINGS DUE TO COTTON CONVEYING SYSTEM	
Cost of hand trucking, per day—44 hrs. @ $0.20	$ 8.80
Cost of conveying by air	3.19
Net saving per day	$ 5.61
Net saving per year—$5.61 × 300 days	$1,683.00
Net annual return on investment	337 per cent

[1] Allowing for interest earned by depreciation reserve.

[1] See MANAGEMENT AND ADMINISTRATION, May 1924, pp. 557-562; June 1924, pp. 693-694; January 1925, pp. 51-55.

[2] Data on equipment manufactured by B. F. Sturtevant Company, Euclid Crane and Hoist Company, and the Link-Belt Company prepared by the A. C. Nielsen Company.

TABLE 2. EUCLID HOIST DATA

Reliance Electric and Engineering Company

COST OF OPERATION—TWO 2-TON CRANES IN MACHINE SHOP		
Depreciation—2×$450÷15 yrs. life		$ 60.00
[1] Average interest @ 6 per cent—$\frac{16}{15}\times\frac{\$900\times0.06}{2}$		28.80
Maintenance and repairs		72.00
Total annual fixed expense		$160.80
Fixed expense per day—$160.80÷280 days		$ 0.57
Power		0.14
Total operating cost per day, 2 cranes		$ 0.71
COST OF OPERATION—3-TON CRANE IN TESTING AND SHIPPING ROOM		
Depreciation—$650÷15 yrs. life		$ 43.33
[1] Average interest @ 6 per cent—$\frac{16}{15}\times\frac{\$650\times0.06}{2}$		20.80
Maintenance and repairs		40.00
Total annual fixed expense		$104.13
Fixed expense per day—$104.13÷280 days		$ 0.37
Power		0.08
Total operating cost per day		$ 0.45
SAVINGS EFFECTED BY 2 CRANES IN MACHINE SHOP		
Additional man required with hand crane—9 hrs. @ $0.60 per hour	$ 5.40	
Time saved and increased efficiency of men—8 per cent × 12 men×9 hrs.×$1.90 per hour	16.42	
Total saving per day	$21.82	
Less operating cost, 2 cranes	0.71	
Net saving per day, 2 cranes	$21.11	
Saving per year— 21.11×280 days		$ 5,910.80
SAVINGS BY CRANE IN TESTING AND SHIPPING ROOM		
Additional man required with hand crane—3 hrs. @ '0.60 per hour	$ 1.80	
Time saved and increased efficiency of men—8 per cent × 8 men×9 hrs.×$1.90 per hour	10.94	
Total saving per day	$12.74	
Less operating cost	0.45	
Net saving per day	$12.29	
Saving per year—$12.29×280 days		3,441.20
Saving per year, 3 cranes		$9,352.00

[1] Allowing for interest earned by depreciation reserve.

The crane in the shipping room is used to handle completed motors in sizes from 5 to 250 hp. A summary of the savings brought about by these 3 cranes is given in Table 2.

Cranes and Hoists

An installation of eight Euclid hoists during the past seven years has brought about annual savings of $8086.40 in the plant of the National Wrought Iron Annealing Box Company. These hoists are used to handle structural angles, beams and plates. The capacities of the hoists are two 7-ton, three 5-ton and three 10-ton. All are floor controlled. Loads vary from 100 lb. to 40 per cent above rated capacity. Hoists are operated by individual workman. Operating costs on the 5-ton hoists are $159.20 per year, while the wages of the men saved would amount to $1170, giving a net saving of $1010.80 per year on this size.

A Link-Belt 2½-ton crane at the plant of John Maneely Company has been in operation for almost ten years and is credited with a saving of $5018.12 annually. It has handled loads as high as 4 or 5 tons, is used in the processing of pipe up to 20 in. in diameter, and is operated by one man. The saving in general handling charges is $3125, and that in machine operators' time is $1850. Higher piling saves floor space worth $500 a year. The total cost of operating the crane is $456.88 annually, bringing the net savings to the amount stated above, $5018.12.

An installation of a Link-Belt hoist at Cattie Brothers Corporation is used to handle materials through galvanizing processes. This hoist is mounted on a double girder bridge crane with a span of 30 ft., a lift of 18 ft., and a travel of 80 ft. It handles 25 to 40 tons per day, in loads varying from a few hundred pounds to 3½ tons, at a cost of $0.36 per day, or about $0.01 per ton. It has saved $3125 in labor annually, and deducting from this an operating cost of $111.47, there is left a net saving of $3013.53 per year. This is a return of 389 per cent on the investment, which repays the cost of the hoist in approximately 3 months.

Five Link-Belt hoists installed at the Paterson Parchment Paper Company are used to handle 500 to 550 lb. rolls of paper to the cutting machines. They have a capacity of 1000 lb. each, are electrically operated, and are located over the stands for the paper rolls. Each stand holds 10 rolls, 2 sets of which are used per 9½ hr. day. Usually all the rolls on a machine are changed at the same time.

These hoists have been in service over 8 years and hence there has been opportunity to obtain accurate records of the cost of maintenance and repairs on them. Details of the total annual savings are presented in Table 3.

A Yale and Towne installation of an electric hoist at the Steel Sales Corporation has brought about an annual saving of approximately $2810. A complete analysis of this installation and the economies it accomplished is given in Table 4.

Another installation of four 1-ton spur-geared Yale blocks at the Edgar T. Ward's Sons Co. plant was made to handle cases of steel sheeting weighing from 400 to 750 lb. each. Four laborers at $0.50 per hour were formerly required to remove this material from hand trucks and pile it. Two days were required to handle

TABLE 3. LINK-BELT HOIST DATA

The Paterson Parchment Paper Company

OPERATING COST OF 1,000-LB. STATIONARY HOIST		
Depreciation—$450÷20 yrs. life		$ 22.50
[1] Average interest at 6 per cent—$\frac{21}{20}\times\frac{\$450\times0.06}{2}$		14.18
Maintenance and repairs		25.00
Power used per year, approx.—380 kw. hr.×$0.03		11.40
Total cost per year		$ 73.08
Cost per day—$73.08÷280		$ 0.26
Avg. cost per roll handled—$0.26÷20		$ 0.013
SAVINGS EFFECTED BY HOISTS		
Labor eliminated by use of electric hoist replacing chain blocks on 5 machines—2 men×$1,330		$2,660.00
Time saved per machine per day—1 hour		
Production of each machine increased about 13.3 per cent		
Value of saving in overhead and cutting machine operators' labor costs per machine per year, approximately—$375		
Saving per year on 5 machines—$375×5		1,875.00
Total saving per year with hoists		$4,535.00
Cost of operation of 5 hoists—$73.08×5		365.40
Net saving per year		$4,169.60
This saving pays for these 5 hoists in less than 7 months.		

[1] Allowing for interest earned by depreciation reserve.

TABLE 4. YALE AND TOWNE HOIST DATA

Steel Sales Corporation

BEFORE IMPROVED MATERIAL-HANDLING EQUIPMENT WAS INSTALLED

Average size of units—volume—4¼ cu. ft.
weight—{maximum—1,000 lb. / minimum—600 lb.
Are they uniform or varied.....
Distance to be lifted—5 ft. 6 in max.
Frequency of lifting—per month—4,375 per day—175 per hour—22
Nature of container if any—none
Weight of container if any—none
Volume of container if any—none
Number of men required—4
Class of men used—laborer 4 Rate paid per hr.—$0.56
Time required for lifting—received on hand trucks
Total distance load moved from starting point to finish—80 ft. max.
Distance moved each time handled—80 ft. max.
Number of times handled from starting point to finish—once
Method employed for lifting—manual
Medium of transportation—hand trucked
Time required for moving—2 min.
Time required for unloading or placing—2 min.
Total amount of material conveyed per {day—70 tons hour—8⅓ tons / month—1,750 tons

AFTER MATERIAL-HANDLING EQUIPMENT WAS INSTALLED

Type of hoist—{electric / chain
Number of hoists in use—3
Number of men required—2
Capacity of hoist—two 1-ton and one ½-ton
Size of units lifted—4 in. ×16 in. ×8 ft. 0 in.
Weight of unit lifted—600 to 1,000 lb.
Time required to lift each load—25 sec.
Height of lift—5 ft. 6. in max.
Frequency of lifting—{per day—175 per hour—40 / per month—4375
Volume of container if any—none
Weight of container if any—none
Cost of all hoisting equipment—$930
Specify if trolley or truck is used—trolley
Total distance load moved from starting point to finish—80 ft. max.
Number of times load handled between starting and finishing point—one
Number of trolleys in use—three
Number of men required for conveying—one
Cost of all conveying equipment exclusive of hoists—$1,320
Total amount of material conveyed per {day—70 tons hour—16 tons / month—1750 tons

SUMMARY OF RESULTS

Reduction in men—2
Labor costs saved—$8.96 per day
[1] Percentage of increase of production—100 per cent

SUMMARY OF EQUIPMENT PURCHASED

Total cost of installation—$2,250
Per cent saving on investment—125 per cent per year
Length of time required to save cost of investment—approx. 9 months

[1] Increase in production is caused by material being handled twice as fast leaving the men free for other work for a longer period each day.

from 40 to 50 tons, or one freight car load of the sheeting. By using a hoist 2 men can now lift 2 or 3 cases at a time, handling time has been reduced to one day per car of 50 tons, storage space is increased 150 per cent, men required in a freight car have been reduced from 7 to 4, and labor costs on these men reduced from $63 to $18 per carload of material handled. A saving of $1 per ton of material is credited to this installation. The total cost of the hoists was $1000 and the return on the investment is calculated at 100 per cent, annually.

The Roeper Crane and Hoist Works, Inc., installed an electric hoist in the plant of the Summerill Tubing Company for use in the pickling department. This hoist handles an average load of 1200 lb. at the rate of about a ton an hour, replacing a chain block previously used. Steel bars are taken from the annealing furnace to the pickling tanks, the material being handled in bundles. The savings calculated are listed in Table 5.

Overhead Carrying Systems

At the Case and Risely Press Paper Company a Louden overhead carrying system costing $600 was installed to convey wet pulp to heaters. The saving of time in the furnish, 12 hr. per week, is credited as $280.80, the savings in wages, $146.12, and the total saving the sum of these two, $426.92 annually, in addition to economies in intangibles.

Portable Conveyors

Barber-Greene conveyors have produced savings of $1672 per year at the plant of the General Carbonic Company.[3] A series of 3 of these conveyors handles coke from pits underneath railroad tracks up at an angle of 40 deg. and discharges it into a overhead bin, averaging about 20 tons per hr. with 2 men feeding the first conveyor.

Originally this material was handled by manual

TABLE 5. ROEPER HOIST DATA

Summerill Tubing Company

PICKLING DEPARTMENT

Normal output—10 tons per 10 hr. day
68 lifts of 5 ft. or 6.8 lifts per hr.
Average load—1,200 lb.

WITHOUT ELECTRIC HOIST

	1st year	After 1st year
Chain block cost	$ 100.00	.....
Interest—6 per cent	6.00	6.00
Depreciation—5 per cent	5.00	5.00
3 laborers @ $3 per day for 275 days	2,475.00	2,475.00
Totals	$2,586.00	$2,486.00

WITH ELECTRIC HOIST

	1st year	After 1st year
Electric hoist cost	$ 595.00	.....
Interest—6 per cent	35.70	$ 35.70
Depreciation—10 per cent	59.50	59.50
Current @ $0.10 kw. hr.	29.20	29.20
Repairs—rope and brushes due to acid fumes	30.20	30.20
2 laborers @ $3 per day for 275 days	1,650.00	1,650.00
Totals	$2,399.60	$1,804.60

SUMMARY

	1st year	After 1st year
Cost, for year, with chain block	$2,586.00	$2,486.00
Cost, for year, with electric hoist	2,399.60	18,04.60
Saving	$ 186.40	$ 681.40

A saving of approximately $0.25 per ton for every ton lifted.

TABLE 6. BARBER-GREENE CONVEYOR DATA

General Carbonic Company

COST OF OPERATING CONVEYORS

Depreciation $3,500 ÷ 12 yrs. life	$ 291.67
[1] Average interest at 8 per cent—$\frac{13}{12} \times \frac{\$3,500 \times 0.08}{2}$	151.67
Insurance at 2 per cent—$3,500 ×0.02	70.00
Repairs and maintenance, estimated	800.00
Power—3,000 kw. hr. ×$0.03	90.00
Labor—2 men ×300 hours ×$0.50 per hr.	300.00
Total annual operating cost	$1,703.34
Cost per day—$1,703.34 ÷ 300 days	$ 5.6778
Cost per ton—$1,703.34 ÷ 4,000 tons	$ 0.4258

COST OF HAND METHOD

Cost per 40 ton car—5 men ×9 hrs. per day ×1½ days ×$0.50	$ 33.75
Cost per ton—hand method—$33.75 ÷ 40 tons	0.8438
Cost per ton—conveyor method	0.4258
Net saving per ton	$ 0.4180
Net saving per year—$0.4180 ×4,000 tons	$1,672.00

[1] Allowing for interest credited on depreciation fund.

[3] Data on Barber-Greene conveyors prepared by H. P. Gould Company.

labor. Five men with wheel-barrows took 1½ days to unload and store a 40-ton car of coke. The substitution of mechanical conveyors repaid the original investment in about 2 years. Table 6 lists the savings.

In the Mechanical Rubber Company plant a Barber-Greene conveyor handles coal from hopper bottom cars into dump cars which carry it to storage or to the boiler-room. About 12,000 tons per yr. are handled, in addition to 2000 tons of ashes. The latter are taken by dump cars to a storage pile and from there loaded on trucks by the conveyor. On the average, the conveyor operates 3 hr. per day, handles 46 tons of material, and requires 3 attendants. The cost of operation is slightly over $0.13 per ton of material handled, or $6.06 per 3 hr. of use.

When handling ashes in bulk from the yard into trucks to be taken to the dump or to building operations for filling in, this conveyor has loaded a 5-ton truck in 6 min. on the average.

In Table 7 additional data are presented on economies produced by material handling equipment. Other classes of apparatus will be listed in a following issue.

The calculations of savings assembled in this compilation are significant. Figured out on several different kinds of equipment and by several methods, they nevertheless are alike in proving economies. Back of each installation has been a study of conditions to be met, and a correct use of apparatus when installed. Both maker and user in every case of this kind desire to accomplish the greatest savings, and, when a suitable type of equipment for any job of material handling has been selected, immediate, substantial, and lasting economies are certain to result.

TABLE 7. DATA ON ECONOMIES OF VARIOUS TYPES OF MATERIAL HANDLING EQUIPMENT

Comparisons with hand methods or semi-mechanical equipment given where available. In other cases operating data only are tabulated.

Item	Type of Apparatus	Plant Where Installed and Date	Make	Handling Service for Which Used	Number Used	Loads Handled	Men Required	Men for Hand Methods	Cost of Handling by Hand	Cost of Handling by Equipment	Total Savings by Use of Equipment per Yr.	Additional Advantages Credited
1	Pneumatic conveyor[1]	Valley Waste Mills	B. F. Sturtevant	Cotton waste refuse	1	15,000 lb. per 10 hr.	0	3		Refuse $0.33 per bale Clean stock $0.072 per bale		Suction increases capacity of machine 5 to 8 per cent
2	Electric traveling crane	West Leechburg Steel Co.	Euclid	Machine shop service	1	100 lb. to 5 tons	1	4			$4,745.00	
3	Electric traveling crane	Keystone Steel & Wire Co., 1922	"	Wire fence	3	600 lb.				$0.05 per ton		Pile material 25 ft. high
4	Monorail hoist	Standard Silk Mills Co., 1923	Link-Belt	Bobbins, paper, silk warping	1	Up to 600 lb.	2 men half time	2 to 4			2,814.70	Reduced labor turnover
5	Overhead carrying system	United Metal Co.	Louden Machy. Co.	Melted brass	1	45 lb.					7,500.00	Saves 6 men
6	Overhead carrying system	Architectural Tile Co.	"	Wall tile	1						5,000.00	Saves 4 men
7	Overhead carrying system	Greiss-Pfleger Tanning Co.	"	Patent leather on frames	1						5,000.00	
8	Overhead carrying system	Klearflax Linen Rug Co.	"	Rug rolls and rugs	1	600 lb.					4,000.00	
9	Overhead carrying system	Koller Fertiliser Co.	"	Fertilizer	1						3,700.00[2]	
10	Overhead carrying system	H. R. Mallinson & Co.	"	Bales of silk	1						1,544.00	
11	Overhead carrying system	Boston Mfg. Co.	"	Yard beams	1						1,000.00	
12	Overhead carrying system	P. J. Vogel	"	Melted brass and aluminum	1	60 lb.					500.00	
13	Portable conveyor	American Glue Co., Indianapolis, Ind., 1920	Barber-Greene	Steamed bone	1		1	4[3]	$ 772.20	$ 366.08	406.12	Used also for coal
14	Portable conveyor and loader	Crume Brick Co.	"	Sand and gravel	2	150 tons per day	2	6 to 9	7,200.00	3,297.86	3,902.14	Insures steady production
15	Portable conveyor	Rockford Sand & Gravel Co., 1920	"	Sand and gravel	1	525 cu. yds. per day	1 half time			758.52[4]		Saves moving stationary conveyor
16	Portable conveyor	Pawtucket Gas Co.	"	Coke and oxide	2	1,400 tons per yr.	Coke 3 Oxide 6	Coke 4 Oxide 6	1,050.10	536.04	514.06	Increases handling speed. Reduces storage

[1] Equipment cost: Items (1) $12,633.39; (3) $2,500 per crane, installed; (4) $525; (5) $1,000; (6) $1,500; (7) $3,500; (8) $1,509.27; (9) $500; (10) $1,400; (11) $240; (12) $85; (13) $831.17; (14) $2,203; (15) $1,100.95; (16) $3,000.

[2] Saves $500 per yr. over old wheel-barrow system, $12.00 per day total.

[3] Present method 1 man, 15 hr. per week; hand method 4 men, 12¼ hr. per week.

[4] Cost per ton, $0.0145.

When Your Salesmen Grow Stale

By CHARLES C. CASEY

President, Work-Organizer Specialties Company

WHAT is to be done with the branch manager or salesman who is growing stale on his job? Almost invariably he has been, and still is in large measure, a valuable man. He knows the territory, has a personal following; there is substantial running business that would be adversely affected by his removal. There is the consideration of loyalty to him as an established employee.

Yet, unquestionably, when he goes stale, he is running around in a circle. He is spending too much time with established business and not enough in breaking into new offices. In fact, it is not unusual for him to have a firmly fixed belief that he has seen everybody, that there are no new prospects to be called upon. Frequently some younger man selling competitively in the same territory, a product of a later-day school of salesmanship, and with his spurs still to win, is running rings around him.

A Real Problem

It is a real problem found everywhere, every day. It is, in fact, one of the acid tests to which sales management is put. For the quick answer, wholesale removals are far from a remedy. Such treatment is most destructive of morale; and the immediate gain is more than offset by immediate losses.

Some Effective Remedies

Plain talk is one of the most effective remedies. "I called Jones into my office early one morning just a year ago this month," said a highly successful sales manager to me recently. "When he was seated, I got up, locked the door and put the key into my pocket. And then he listened to three hours of the plainest, most unvarnished truths he had heard for many a long day. Just yesterday he came in and thanked me for one of the best things that had ever happened in his life." Needless to say, there was no berating here. The sales manager was the more mature and clearer-seeing individual with the ability of making the other see the true situation, despite the sting of it.

No salesman can secure business without "exposing" himself, as the saying is. Orders do not necessarily follow mere number of calls; but no good volume comes without a considerable number of that same demolisher of shoe leather and energy. Good results have been obtained in waking up the stale salesman by keeping a tabulated individual record of effective calls made by the whole sales force and, at the proper time, putting the cold facts before the slothful individual.

When staleness comes to the man in the field, is not the sales executive back in the home office called upon to bear the responsibility, in part at least? His is the main responsibility of seeing new markets and applications and, through contact with his salesmen, both personal and by correspondence, leading them to these opportunities. He has the strategic position back in general headquarters, also the time, to secure the fresh slant, the concrete evidence of merit and superiority, which, driven home time after time, wins the stubborn prospect. Has this ammunition gone regularly and inspiringly to the men out on the firing line?

How the Head of the Packard Motor Company Did It

Alvan Macauley, now head of the Packard Motor Company, and formerly general sales manager and later general manager of the Burroughs Adding Machine Company, met the stale-district-sales-manager problem and solved it with interesting results.

His Toledo manager for Burroughs was slowing up, and complained of his territory being "worked out." At about the same time, the Omaha manager came to the same view of his territory. All prospects were sold, they believed, and the district quota could no longer be made.

Each, without either being given any inkling of the true situation, was offered the other's job as an opportunity to handle a territory where another man was falling down. Each grasped the chance gladly; and each put a "worked out" territory over the top in two months' time. Subsequently, when they discovered the move, both admitted that the joke was on them, but they had both obtained a good territory and both were satisfied.

The manager of the Minneapolis territory was not producing as much business as he should, and over the protests of the other sales executives, Mr. Macauley replaced him with a new man. The very first month the new man made the entire district agency quota in one office building just across the street.

Salesmen, according to Mr. Macauley, become stalemated on both territories and individual prospects. Successive turndowns lead to the conclusion that the prospect is "N.G." The "N.G." list grows to formidable proportions. A new salesman put on these same prospects does not call *again;* he just *calls.* He brings a new contact and a new viewpoint. The case is not yet on record with him. The prospect had no backing down to do. Orders invariably resulted.

One of the biggest commercial stationers and office supply houses in Boston was canvassed for a new office equipment device. For some reason the line was turned down. Over a period of four years the salesman continued to call on the dealer without result. Finally an imitation was offered the dealer by another house and he placed a good-sized order. The imitation dis-

appointed him but showed him the sales possibilities of such equipment. He still side-stepped the old salesman, but when a new salesman from the old house was sent to him he placed a large order and became the leading Boston dealer in that line.

Having once refused the first salesman, he would not reverse himself, and kept the line out of his store "to save his face." Probably another salesman could have sold him soon after his first refusal but the first salesman could not make him act.

No Territory Ever Worked Out

It is unescapably true that there is nothing permanent but change in business and industry. The prospect that was dead yesterday flares into life today; no prospect is ever "N.G."

A new representative took hold of a territory for a cash register company. He made up a list of merchants rated as too small to buy registers. These smaller business men were flattered. Also they had grown since they were rated as too small. The results were gratifying. They bought and, surprisingly, they bought the better machines and paid cash.

Of course, there are dangers in the plan of transferring men—some of them cannot be transplanted. One man that Mr. Macauley wished to change owned the building in which the agency was located, owned his own home in the city, and was a director of a bank. He could not be transplanted, but he was wasting himself and his future, and the only thing left was to let him go. He had ability but was not accomplishing as much for his house as a new man with less ability could accomplish. He had attained a responsible position but was not accomplishing as much for himself as he could accomplish with a new line of equal merit. The attitude assumed by Mr. Macauley is a reflection of the bigger basis of management.

Mr. Macauley once told me that he had found the kindest thing to do to many men was to fire them so they would get out of their rut, start fresh, and get a new grip on themselves and their work. Such action is beneficial to both the man and his company.

Plain talk, shifts, guidance, the introduction of new blood to help—removal where necessary. These are the cures for the staleness that threatens every salesman. And they invariably prove blessings for the company—also for the salesman himself.

Handling Coal in Alameda

By CHARLES W. GEIGER

A COAL-HANDLING installation of unusual size is operated by a coal company on the Alameda side of the Oakland estuary in California. The principal feature of the installation is the immense gantry crane portrayed in Fig. 1. The total length of the crane including the overhang on either end is 361 ft. The bridge travels on steel rails which are 200 ft. apart

FIG. 1 GANTRY CRANE FOR HANDLING COAL

and they extend a distance of 550 ft., providing over 100,000 sq. ft. of storage space.

Two sets of railroad tracks run the entire length of the storage yard on one side and a third track parallels the other side of the storage space. A large clam shell bucket, faintly visible in Fig. 1, is used for loading and unloading the coal. Because of the extensive overhang it is possible to transfer coal direct between the storage yard, freight cars, or barges in the estuary. The capacity of the equipment is approximately 100 tons of coal per hour.

All equipment on the bridge as well as propelling motors for moving it on its tracks are electrically operated and are all controlled from the operator's cab suspended from the bridge. Electric current for the motors is furnished through a third rail system.

The entire surface of the storage yard has been floored with a layer of concrete 8 in. thick, which effectually protects the coal from ground moisture. Inasmuch as coal is not usually stored for a long period of time but is constantly being removed and replaced by new shipments, no special effort is made at regularity of storage piles. Fig. 2 shows several piles of coal and one set of tracks upon which the crane runs.

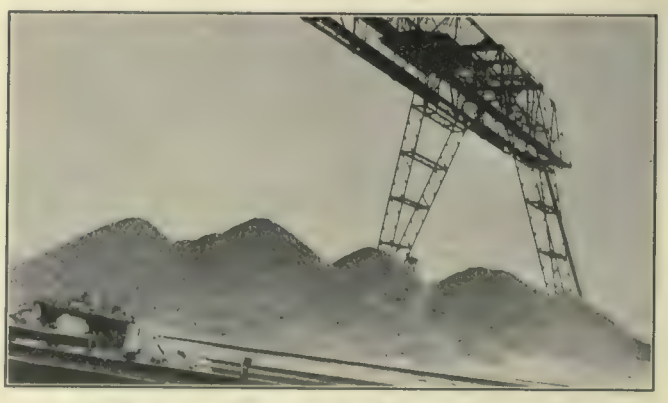


FIG. 2 PILES OF COAL AND ONE SET OF TRACKS UPON WHICH THE CRANE RUNS

Making Freight Shipments Pay Profits

There Are Many Corners to Be Cut by the Shipper Who Knows How

By ROBERT T. KENT

Mechanical Engineer

THE manufacturer who neglects to study the freight rates applying to the shipment of his product, and of raw material on which he has to pay inbound freight charges, is losing a great possible opportunity to effect considerable economies in his business. As a matter of fact, a study of freight rates may enable him to increase his business in competitive localities.

Factors Governing Transportation Cost

Several considerations enter into the making of a freight rate between two given points:

1. The route followed by the shipment.
2. The class of shipment.
3. The weight of the shipment, i. e., whether it is in carload or less-than-carload lots.
4. The method of packing.
5. The classification territory from and to which the shipment is made.

Each one of these items has a direct bearing on the cost of transportation. It is by a study of the influence of them separately and in conjunction with each other, that the manufacturer can determine the combination that will give him the lowest cost of moving his product to market consonant with time requirements.

"The freight is against me," is a statement often made in explaining—we almost said in excusing—a restricted distribution and sale of goods. Often this condition is unavoidable. But the freight rate can very frequently be made *for* the shipper if he will tackle his shipping with a full understanding of all the possible ways and means to lower rates. Mr. Kent's article amply indicates how—even to the point of winning entirely new markets.

The Influence of Route

The rates for the same shipment between the same points are not identical for all routes. For the great majority of shipments there are usually two or more rail routes available, and frequently a water route, or a combination. It is these combinations that offer the opportunity to the manufacturer to save money. The time that goods will be in transit usually will be much shorter over one route than over the others, which may involve, not only a longer haul, but the breaking up of trains at junction points. With equal rates, therefore, all shipments would naturally be forwarded over the direct route.

In order to attract business and divert some of this traffic, some compensating advantages must be offered by the longer route. This advantage is offered in the form of a lower rate by the longer route. Where the time element is not a governing factor, the manufacturer may effect a substantial saving in his transportation charges by shipping over the longer route.

Through Rate Usually Lower

Another factor to be considered is whether there is a through rate between the point of shipment and point of delivery over the route selected. Thus, in Fig. 1, there are two routes available between A and B. Over the route through E a through rate exists, while the rate over the route through C and D is made up by adding the local rates between A and C, C and D, and D and B. The through rate usually, although not always, will be lower than the rate made up of the sum of the local rates.

Again, there may be through rates quoted over both of the routes shown in Fig. 1, but one may be higher than the other. If the manufacturer does not look into this question he may continue to pay higher freight charges than is necessary for a long period of time. Although railroads are required, when no route is specified, to forward shipments over the cheapest route, they are also required to follow the shipper's routing where possible. Even if they are compelled by stress of weather, congestion of traffic or embargoes to ship by another route, they can collect the tariff only for the route specified. Hence when a manufacturer specifies a given route without knowing that there is a cheaper route, he is charging himself with an unnecessary expense.

The question of terminal facilities also has considerable bearing on the selection of route. One road may have a direct connection, by means of a siding, to the ultimate destination of the shipment, while the terminal of another may lie on the other side of the city. If shipment is made by the second road, there may be switching charges to pay in order to have the shipment transferred to the road connecting directly with the final destination, whereas if the shipment had been routed over the first road from the last junction point this switching cost would have been obviated.

As a rule, water transportation is cheaper than rail. Also where there is a combination rail-water route available, it usually will be found to be less costly than an all-rail route. A good instance of this is the traffic from the iron mines in the Lake Superior region to the blast furnaces near Chicago, Cleveland, and Pittsburgh. During the period that navigation is open on the Great Lakes, ore is shipped by ore steamers from the docks on Lake Superior to Chicago and Cleveland. When the lakes become frozen, and ore shipment must be made all-rail, the difference in cost is so great that practically no ore is moved.

Frequently, when a shipment can be routed so that it moves against the prevailing direction of traffic, a lower rate obtains than when it moves with the traffic. That is, if a railroad has a heavy preponderance of freight in one direction, it must send back many of its cars without loads. Since this is an item of expense pure and simple, any freight that may be obtained for these otherwise empty cars will be just that much gain for the road. Consequently, freight rates may be much lower in one direction than another. Knowledge of this fact may enable a manufacturer to develop markets that he has not heretofore attempted to reach.

Before leaving the subject of routing, a single instance may be given to show the importance, in actual money values, of a correct choice of routes. Ripley in his book on railroad rates cites the case of a certain shipment from New York to Chicago. The shipper had the choice of six possible means of transportation. The cost of the shipment per 100 lb. by each of these routes was as follows:

Standard all-rail	$0.75
Differential all-rail	0.69
Ocean steamer and rail	0.65
Standard rail and lake steamer	0.62
Differential rail and lake steamer	0.52
Canal and lake steamer	0.42

If the time element were of minor importance, it would be possible to effect substantial savings on large shipments by taking advantage of one of the slower routes as by canal and lake steamer.

The Importance of Classification

Of perhaps more importance to the manufacturer than wise routing is a study of the classification of his product. The freight rate that he will pay depends on the class in which his shipment falls, and the difference in rate between one class and the next higher may range from 15 to 20 per cent.

There are two types of railroad freight rates—commodity rates and class rates. The former is a specific rate of a certain number of cents per 100 lb. or per ton, for the movement of a specific material or commodity from one point to another. Commodity rates usually apply to bulk shipments such as coal, ore, grain, brick, cement, etc. All other goods, for which there is no specific commodity rate, are governed by some "class" rate.

The number of classes varies according to the territory in which the railroad lies, ranging from 11 in what is known as Southern Classification Territory to 16 in the Western Classification Territory. The significance to the manufacturer of the difference in classification in the different territories is that goods that are in one classification in one territory may be in a quite different one in another. If, then, shipment is made from one classification territory to another, it is important to find out which classification will govern. Since the class assigned to shipments depends on several factors, it is advisable to ascertain those requirements which will bring the shipment into

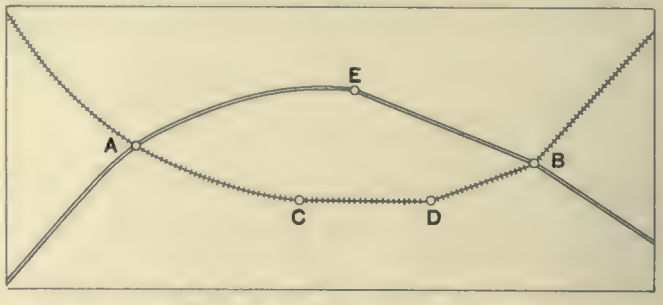


FIG. 1 COMPARISON OF THROUGH RATES AND LOCAL RATES

the lowest class possible in the territory governing the shipment.

There are three principal classification territories in the United States, as shown in Fig. 2. These are: The Official Classification Territory, the Southern Classification Territory, and the Western Classification. In addition there are local territorial classifications, such as that of the New England Freight Rate Association, and a number of state classifications.

Securing a Lower Classification

Fig. 3 is a sample page of the Consolidated Classification, which is a publication showing the class assigned to the various articles classified in the Official, Southern, and Western territories. An examination of this will show how important it is for a manufacturer to be thoroughly acquainted with the various classifications to which his goods will be subject. Thus wooden tubs, loose, carry a first-class freight rate in all three classification territories. If they are nested, they carry a lower rate, but which is higher in the Official and Western territories than in the Southern. If shipped in carload lots, they take a still lower rate. All these facts must be considered in making shipments, for it is possible by proper routing or by a change in method of loading to take advantage of a lower classification, with a substantial saving in freight charges.

The description of a shipment in the shipping papers is not a matter of scant consideration. Many articles are susceptible of two descriptions, both of which are accurate. Articles of both descriptions may be listed, in the classifications, but one may be in a lower class than the other, and consequently will carry a lower freight rate. Hence, care should be exercised

to ascertain if there is in the classification a different description than the one commonly used and which will also apply to the article in question. Attention to this point will often effect material reductions in freight costs without influencing other factors.

Securing Reclassification

It is sometimes possible to have the classification of an article changed so as to secure a lower freight rate. This is effected by application to the classification committee in charge of the particular territory involved, and by showing good, substantial reasons for the change. The following are some of the items that are studied in the classification of freight shipments:[1]

1. The uses to which the commodity is put.
2. The material of which the commodity is made.
3. The way in which the commodity is packed.
4. Carload or less-than-carload shipment.
5. Dimensions and weight of the article or package.
6. Weight per cubic foot.
7. Value, and especially value per cubic foot.
8. Weight that can be loaded in a standard car.
9. If shipped in carloads, the number of carloads per annum.
10. If shipped in mixed carloads, the articles with which mixed.
11. Where produced.

FIG. 2 MAP SHOWING RATE CLASSIFICATION TERRITORIES

Effect of Weight on Class Assigned

The weight affects the class assigned to a shipment in two ways. First, an article which has a large weight per cubic foot usually obtains a lower classification than one which is more bulky for the same weight. Second, a shipment large enough to fill a car is given a lower classification than one which will only partly fill the car.

If the shipment is large enough to fill a car, the manufacturer can take advantage of the carload rate, which is usually one or two classes lower than the less-than-carload rate. The carload rate again depends on the weight per cubic foot, for the reason that the railroads establish a minimum weight for a carload for the different materials. These minimum carloads are based on the quantity necessary to fill a standard car. Since with the heavier materials a greater weight can be put in the car, the expense of hauling the cars necessary to accommodate a given shipment is less, and the lower classification applies. This is illustrated by some of the items listed in Fig. 3.

Thus item 7, wooden-ware kits, which are bulky, are listed in the Western classification as class 3 in carload lots, with a minimum carload weight of 12,000 lb. On the other hand, item 3, clothes pins, which are made of the same material, can be packed in much smaller space and, therefore, have a greater weight per cubic foot. They are given a minimum carload weight of 30,000 lb., and are listed in class A, which in a strictly numerical classification is equivalent to 6th class.

Changed Shipping Methods Bring Lower Rates

The practical significance to the manufacturer of the effect of weight on class is that, by a change in his shipping methods, he may be able to put his goods in a lower freight class and thereby reduce his cost of carriage. For instance, in the Western classification, wooden desks in crates in less-than-carload lots are in class 1. If wrapped in burlap, they are in class 1¼. The difference here is probably due to the greater liability to damage of the uncrated goods. On the other hand, if the desks are shipped "knocked-down" thereby occupying less space, they become class 1 freight when wrapped in burlap, and class 2 freight when crated.

On shipments running into carload lots, the saving in freight may be considerable, especially when the still lower class assigned to carloads is taken into consideration. Similarly, with machinery, lower classification may be obtained by shipping it disassembled rather than set up and ready to run. There are great possibilities for the manufacturer in the study of this phase of the freight rate problem, but each manufacturer must view the problem in the light of his own peculiar conditions.

Where a manufacturer has a number of less-than-carload shipments to make to adjacent points, it may be possible for him to make an appreciable saving in his freight charges by combining these smaller shipments into carloads which he consigns to himself, either at a point fairly central to the ultimate destinations, or to the destination of the largest order or group of orders. Arrived at this point, he or his

[1] "The Business of Railway Transportation," Haney, 1924.

agent breaks the carload up into less-than-carloads and ships the individual orders to their final destination. Here the saving in freight costs must be balanced against the expense of breaking up the carload lots and reconsigning them.

While carload rates usually apply to full carloads of one commodity, they may also apply to carloads made up of several different commodities shipped by one shipper to a single consignee. In this case, the entire shipment takes the rate of the highest class of merchandise in the car. The use of mixed carloads should, therefore, be attended with caution, and careful attention should be given to the class and relative quantity of each type of goods that go to make up the shipment.

CONSOLIDATED FREIGHT CLASSIFICATION NUMBER 3
Publishing the Ratings, Rules and Regulations of the Official, Southern and Western Classifications 447

Item	ARTICLES	RATINGS Official	Southern	Western
	WOODENWARE—Continued			
1	**Bowls:**			
	In barrels, boxes, crates or racks, L. C. L.	3	3	2
	In packages named, C. L., min. wt. 24,000 lbs., subject to Rule 34.	5	4	A
2	**Churn Dashers:**			
	In boxes or crates, L. C. L.	3	3	2
	In packages named, C. L., min. wt. 24,000 lbs., subject to Rule 34.	5	4	A
3	**Clothes Pins:**			
	In bags, barrels, boxes or crates, L. C. L.	3	3	2
	In packages named, C. L., min. wt. 30,000 lbs., subject to Rule 34.	5	5	A
4	**Dishes or Plates:**			
	In barrels, boxes or crates, L.C.L.	3	3	2
	In packages named, C. L., min. wt. 24,000 lbs., subject to Rule 34.	5	5	A
5	**Firkins:**			
	Not nested, loose or in packages, L. C. L.	1	1	1
	Nested, see Note, in bundles or crates, L. C. L.	2	3	2
	Loose or in packages, C. L., min. wt. 16,000 lbs., subject to Rule 34	4	5	4
6	**Note**—Rule 21 will govern, except the words "One-half (½) of its height" may be substituted for "One-third(⅓) of its height."			
7	**Kits.**			
	Loose or in packages, L. C. L.	1	1	1
	Loose or in packages, C. L., min. wt. 12,000 lbs., subject to Rule 34	3	4	3
8	**Measures:**			
	Not nested, in boxes or crates, L. C. L.	1	1	1
	Nested, in boxes or crates, L.C.L.	2	2	2
	Loose or in packages, C. L., min. wt. 12,000 lbs., subject to Rule 34	R25	4	3
9	**Pails (Buckets):**			
10	Not nested:			
	Loose or in packages, L. C. L.	1	1	1
	Loose or in packages, C. L., min. wt. 12,000 lbs., subject to Rule 34, see Note 1	3	4	3
11	Nested, see Note 2:			
	In bundles or crates, L. C. L.	2	2	2
	Loose or in packages, C. L., min. wt. 16,000 lbs., subject to Rule 34, see Note 1	4	5	4
	Not nested and nested, loose or in packages, C. L., min. wt. 18,000 lbs., subject to Rule 34, see Note 1	4	5	4
12	**Note 1**—Ratings will include not to exceed one cover for each pail.			
13	**Note 2**—Rule 21 will govern, except the words "one-half (½) of its height" may be substituted for "one-third (⅓) of its height."			

Item	ARTICLES	RATINGS Official	Southern	Western
	WOODENWARE—Continued:			
14	**Tubs, Butter, Fish or Lard:**			
	Not nested, loose or in packages, L. C. L.	1	1	1
	Nested, see Note, in bundles or crates, L. C. L.	2	3	2
	Loose or in packages, C. L., min. wt. 16,000 lbs., subject to Rule 34	4	5	4
15	**Note**—Rule 21 will govern, except the words "One-half (½) of its height" may be substituted for "One-third(⅓) of its height."			
16	^ **Bowls; Churn Dashers; Clothes Pins; Dishes; Plates; Firkins; Kits; Measures; Toothpicks; Pails (Buckets), without covers or with not to exceed one cover with each pail; Butter Tubs, Fish Tubs or Lard Tubs,** loose or in packages as provided for straight carload shipments, mixed C. L., min. wt. 15,000 lbs., subject to Rule 34	R26	4	4
17	**Woods, Turned, N.O.I.B.N.:**			
	In bags or bundles, L. C. L.	3	3	2
	In barrels with cloth tops, L. C. L.	3	3	3
	In boxes, L. C. L.	3	3	4
	In packages named, C. L., min. wt. 30,000 lbs.	5	5	A
18	**WOOL:**			
19	**Iron or steel:**			
	In bales or boxes, L. C. L.	1	1	1
	In packages named, C. L., min. wt. 20,000 lbs., subject to Rule 34	3	3	3
20	**Mineral (Rock or Slag Wool):**			
	In bags, barrels or boxes, L. C. L.	3	3	3
	In packages named, C. L., min. wt. 20,000 lbs., subject to Rule 34	5	5	5
21	**Wool, N.O.I.B.N., including Alpaca Hair, Camel's Hair or Wool or Mohair (Angora Goat Hair):**			
22	**In the grease, unwashed or washed, not scoured:**			
	In bags or in bales not machine pressed, L. C. L.	1	2	2
	In machine pressed bales, L.C.L.	2	2	2
	In packages named, C. L., min. wt. 16,000 lbs., subject to Rule 34	3		
	In packages named, C. L., min. wt. 24,000 lbs., subject to Rule 34		4	4
23	**Scoured:**			
	In bags or in bales not machine pressed, L. C. L.	1½	1½	1½
	In machine pressed bales, L.C.L.	1	1	1
	In packages named, C. L., min. wt. 10,000 lbs., subject to Rule 34	2	2	2
	(Ratings published in compliance with order of Interstate Commerce Commission in Case 11424, November 3, 1921.)			

FIG. 3 SAMPLE PAGE FROM CONSOLIDATED FREIGHT CLASSIFICATION

Effect of Method of Packing

The method of packing has a noticeable influence on the cost of freight. In the first place, loosely packed material is bulky compared with its weight, and so tends to go into a higher class. In the second place, careful packing is necessary to afford protection to fragile articles. Since a railroad is liable for damage sustained in transit by any goods entrusted to it, it will protect itself against the possibility of having to pay damages by charging more for any goods that are not given the maximum protection against accident. Fig. 3 shows that many of the items carry lower rates when boxed or crated than when shipped loose. When goods are protected, the railroad will carry them for less money than when they are not so protected.

Likewise, packing the merchandise in such a manner that it will occupy less space per cubic foot brings a lower rate. For instance, in Fig. 3, item 5, firkins, when shipped in packages or loose, are class 1 freight. When nested in bundles or crates they become class 2 freight in two classifications, and class 3 in another.

In such cases the manufacturer has to make the choice between greater expense of packing and lower freight rates. The decision will be based on simple arithmetic, but as a rule the answer will not be in doubt. Good packing almost invariably pays for itself.

A Possibility of Largely Reducing Cost of Doing Business

The foregoing is a sketchy and very incomplete outline of the factors entering into a railroad rate. It has not been our purpose to instruct a manufacturer in the science of rate making, or even to tell him how to determine a rate on his products. The purpose has been rather to point out that by a study of railroad rates, and of the factors that influence them, from the standpoint of his own product and his own business conditions, a manufacturer has the possibility of largely reducing the cost of doing business. Economy in cost of production can well be accompanied by economy in cost of distribution, and to the latter the freight rate is all-important.

It must be remembered that railroad charges are cumulative. The cost of freight is added to cost of raw material. The manufacturer adds to these costs, that of converting the raw material into finished product. He then adds on a percentage for his profit, thus obtaining his selling price. This price then becomes the raw material cost of the next person using the product and the same cycle is repeated, perhaps several times, before the goods reach the ultimate consumer.

It is obvious that by a careful study of the freight rates applying all along the line, the percentage added for profit will be lower without much, if any, decrease in the actual amount of profit. This decrease in percentage of profit may make all the difference necessary for a manufacturer to reach a market where otherwise he would be undersold and unable to compete.

Lynn Plan of Shop Representation

Brings Fair Industrial Settlements Without Strikes

By STANLEY S. RINGER

Lynn River Works, General Electric Company

IN writing about what we call the Lynn Plan of Representation, I want it thoroughly understood that I am not an advocate of the popular public conception of what is known as the American Plan of Industrial Representation. While the plan in operation at the Lynn Works of the General Electric Company is essentially an American way to deal with the industrial problem, it must not be confused with the many different methods in vogue in various industries all over the country, each and every one of them, regardless of the ideals and principles in back of them, labelled the "American Plan." I do not want to be called a propaganda agent for what opponents of representation plans call the American Plan.

Moreover, I want you to understand that I am writing from the viewpoint of a man in the shop, working at the present time at the bench as a toolmaker, and a representative of the men in the department in which I work; also from the viewpoint of a man who was one of the recognized leaders of employees in the labor difficulty which preceded the institution of our plan of representation. From the time of our first election under the plan, I have been connected with it as a representative of the employees, serving on the General Joint Adjustment Committee five consecutive terms, retiring voluntarily after the fifth term, to become once more the section representative in my department.

This plan of industrial representation, which has worked so well, was put into effect by mutual consent of employees and management. For more than six years now, the plan has weathered all storms—as Mr. Ringer, himself one of the workmen, enthusiastically puts it—and proved the effectiveness of the principle of a square deal for all.

Strike Settled on Basis of Plan

Our plan of representation was instituted at Lynn Works following the settlement of a strike which brought approximately 14,000 men and women on the street July 18, 1918. The workers returned to the shops August 2, 1918, and elected three men from among their number to meet with three representatives of the management, and an examiner of the War Labor Board, mutually to work out and agree upon some method by which the employees could be heard on all matters affecting their welfare. Our present plan of representation is the result of the work of these men, and was officially inaugurated November 26, 1918, and has been in operation ever since.

The principle and ideals upon which our plan is based have never been changed, and never will be with the consent of the employees. The principle I speak of is: "There shall be no discrimination, either on the part of employees or management, in respect to race, creed, society, fraternity, or union," and that every employee is entitled to a hearing in any matter which he thinks requires adjustment by committees in which he has equal representation with his employer.

In operation, our plant is divided into sections each containing approximately 200 employees. Several sections are grouped into shops, including a total of not materially more than 600 employees. Each section elects by secret ballot from among their number two representatives to serve a term of one year.

Two forms of committees are used. The representatives of a shop elect three of their number who, with three management representatives, form a Shop Committee whose particular field of activity lies within that shop. General Committees consist of three representatives elected for the position by all the representatives and three members appointed by the management. There are eight General Committees, each one having jurisdiction over some phase of employee relationship such as adjustment, safety, athletics, etc.

If an employee feels that he has a grievance, he has the right to take the question up directly with his foreman, accompanied by one or both of the representatives of his section. Failing to get satisfaction in that way, he can put his case in writing and it will be referred to the Shop Committee covering that particular shop. This Committee, composed of three management and three employee representatives, tries the case in an effort to arrive at a decision. If they cannot satisfy the workman, the case goes to the section superintendent, who reviews all the evidence that has been presented to the Shop Committee and all other available information. If the superintendent cannot settle the case, it next goes to the General Joint Committee on Adjustment. If this committee fails to settle the case it goes to the manager, whose decision is final.

Whenever a committee gives a unanimous decision,

there is no appeal from it. An employee can appeal any decision which has not been supported by all the committee members.

Manager Accepted as Final Arbiter

When the plan was inaugurated, there was a question in the minds of some of the employees because the manager had the final decision in the event of disagreement in the General Committee. This has since been dispelled because, to make anything of such a plan, all parties to it must play the game on the level. The manager cannot be biased. He must make an impartial decision. It is interesting to know that up to May 1924, of about 285 cases which had occurred since our plan was installed, the manager has been called upon to make a decision in only four. Two of these decisions were favorable to the employees and two were favorable to the management.

Committees act in a legislative as well as a judicial capacity. When a Shop Committee meets and there is no regular business before it, it may take up all sorts of questions and problems for investigation which have anything to do with shop conditions. All suggestions made by employees come before their Shop Committee for investigation.

Crises Successfully Handled Under Plan

I am sure that the operation of this plan has saved money for both the company and the employees. We have passed through several critical periods with no serious difficulty. If it were not for our plan, I am sure there would have been conditions which would have caused employees to lose several weeks' pay and the company to suffer considerable financial loss.

We at Lynn have weathered the storm and have sailed away from the rock upon which so many plans of representation were wrecked during the period of readjustment after the war. We passed through two wage reductions without labor difficulty of any kind, and the plan of representation handled this difficult problem on the same principle of which I speak, the "square deal."

Do not misunderstand me and do not think I mean that the workers' representatives sat meekly by and said, "You're right, Mr. Manager, our wages should be reduced." Nothing of the kind, I assure you, because I was a member of the committee that handled this problem. It took the Adjustment Committee days and days with seemingly endless discussion, before we could even concede that it was fair to reduce our wages.

Then came the question of how much of a reduction we would recommend to be put into effect. More seemingly endless discussion, and finally a complete disagreement as to the figure to be set. We finally took a formal vote and put the burden upon the manager of the works to say how much of a reduction to put into effect. This reduction became effective in February 1921, and you can visualize somewhat the sentiment of the rank and file of the workers by the fact that the members of this committee were all returned at the next annual election of representatives.

The second wage reduction went into effect the following August, 1921. The same procedure was followed, except that the employee representatives at this time refused to agree that a wage reduction was necessary. The positions were reversed. The manager had to assume the burden of responsibility of declaring a wage reduction necessary, and requesting the committee to say how much. The employee members of the committee made one recommendation to him and the management members another. The manager's decision was approximately a compromise between the two.

Since that time, there have been two general wage increases granted and several increases not classed as general.

The severest test that any plan of industrial representation can be put to is going through a period of depression, and I cite these things to demonstrate that we at Lynn have had our baptism of fire, and have come through clean, which augurs well for the future. We are a human institution, and as such are not perfect, but those of us who are interested in a square deal in industry, through giving the worker an opportunity to be heard on matters pertaining to his welfare, would do well to check up what is being accomplished at Lynn and elsewhere, where workers and management get together with the cards on the table face up, and sincerely try to establish the mutual confidence so necessary to the well-being of industry today.

An On-the-Square Policy That Has Yielded Big Profits

When this is done, and we believe we are doing it at Lynn, it will not make any difference what name you give the plan. If each party is on the level with itself, it is bound to be square with the other. All the worker asks is to be given fair wages, fair working conditions, and a chance to have his just say regarding these matters. The manufacturer who does it makes the best investment on the market today, an investment that will not only keep the wheels of industry turning and make a profit for his business, but will give that satisfaction which comes to a man who is just to his fellowmen.

If, on the other hand, men charged with the leadership of industries refuse to recognize this fact, these men are bound to go down, because the worker demands these things today, and he is bound to get them one way or another.

It is utter folly for any manufacturer to fail to take advantage of any medium which may be at hand to acquire the confidence of his employees. Some form of employee representation, which can be mutually agreed upon between management and employee, is at least the stepping stone towards the establishment of this confidence and co-operation. I submit that the Lynn Plan of Representation is demonstrating the soundness of this theory and proving to the skeptics that the machinery will work if both sides play the game the American way, "on the square."

Where Have My Profits Gone?

Working Plans for Profits—V

By G. CHARTER HARRISON

Consultant in Management

IT was once stated that mankind will always be under a debt of gratitude to that prehistoric hero who first dared to swallow a raw oyster. Whether he took this daring step under the compelling force of starvation or was moved thereto by the higher motivation of adventurous curiosity will never be known, but generous souls will be inclined to give him the benefit of the doubt and enshrine his memory amongst the glorious company of great experimenters.

The average male American is a born experimenter, as is evidenced by his delight in trying out new radio "hook-ups" which, as soon as they work satisfactorily, are promptly torn down in favor of some new fascinating combination of coils and condensers. It is this spirit of adventurous experimentation which has been the mainspring of human progress and which has contributed so greatly to the industrial and inventive supremacy of these United States.

Management Inevitable

But while this spirit of adventurous experimentation may very properly be called the father of invention, the old adage that necessity is its mother still holds true. As was pointed out in an earlier article in this series, the increase in the number, weight, and speed of ships practically compelled the development of the art of navigation; in a similar manner the increase in the size and complexity of manufacturing operations rendered the development of scientific management equally inevitable and there is no question that if Frederick W. Taylor had not developed the principles of this science when he did, some other pioneer would have arisen to perform this service to the world of industry.

It is also inevitable that the proddings of stern necessity will compel the adoption of more scientific methods of accounting than are now in common use. In my previous article[1] I endeavored to show how the job-order cost plan was a menace to industry and a detriment to profit-making. I referred incidentally to the appalling waste of the time of clerks and shop men which resulted from the deficiencies of this method of cost accounting, but I did not mention a far more serious waste of time, namely, that of the executive for whose benefit the cost system is primarily operated.

The conservation of the time of the business executive is of vital importance, and yet presidents of large corporations will be found spending hours every month poring over undigested detailed cost statements in an effort to extract a few grains of wheat from the bushels of chaff presented.

An Ineffective Method

The very able and conscientious president of a large business was explaining to me a few days ago the procedure he had followed for years in endeavoring to use his cost records as a means of reducing his costs. Monthly his accounting department presented him with detailed cost statements of the numerous articles manufactured during the month previous. He would compare these costs, operation by operation, with the previous month's costs of the same articles. In making these comparisons he, of course, endeavored to apply the principle of exceptions and when he noted any unusually large variation between the two months' costs, he would dictate a memorandum to the superintendent calling for an investigation and report on the discrepancies. As the cost statements were not submitted until about the twelfth of the month following, it is obvious, of course, that the particular item of expense under consideration had been incurred several weeks previous, and as far as I could ascertain the main result of this investigatory procedure was that the organization as a whole developed a remarkable facility in the fabrication of alibis, and in those rare instances when their powers of imagination refused to function satisfactorily, they could always, of course, plead defective memories as regards recalling the details of transactions occurring several weeks previous.

Hidden Losses

There are, as is well known, two kinds of combustion—the rapid conflagration which destroys a million-dollar plant in a few hours and the slow but nevertheless sure combustion of rusting iron. There are two kinds of losses in business—the spectacular obvious loss such as the destruction of the plant by fire just mentioned, and the hidden, insidious, continuous loss resulting from defective methods. The most important difference in these two is that in the former case we can cover ourselves by insurance and in the latter we cannot. Modern engineering provides instant automatic methods to warn us of the existence of fire, and it should be the duty of the accountant to give the executive immediate and automatic methods of warning of the existence of those less obvious but no less real losses resulting from the existence of preventable inefficiencies. It may be stated as an axiom that any

[1] See MANAGEMENT AND ADMINISTRATION for October 1924, p. 361; November 1924, p. 491; December 1924, p. 605; and January 1925, p. 4.

system of accounting which requires the making of investigations to disclose the fact that an inefficiency exists is fundamentally unsound, is dangerous, and hideously wasteful of time.

An Illustration

As a concrete illustration of the proper method of presenting accounting information regarding profits, the reader is asked to refer to the forecast of profits which appeared on Fig. 9 illustrating this series of articles.[2] It was assumed that the net profits of a business for the month of January had been forecasted as being $6,463 and the gross profits as being $27,763. In Fig. 12 in this issue is illustrated the method of determining part of the answer to the question "Where have my profits gone?" This diagram illustrates the method of figuring the actual gross profits of the business and analyzing the variation from the forecast by causes.

The Gross Profit Variation Analysis Sheet (Form P) renders it possible to analyze variations Z from the gross profits easily and effectively; as a matter of fact, though at first glance the process may seem a complicated one, in reality the operations involved are of the simplest character. The information shown on this form may be briefly summarized as follows:

Forecasted gross profits for month		$27,763.00
Actual gross profits for month		22,671.07
Loss in gross profits		$5,091.93
Analysis of above loss by causes:		
Due to cuts in price	$1210.00	
Due to increase in manufacturing costs	1077.93	
Due to loss in sales volume	3075.76	
Total losses	$5363.69	
Less increase in gross profits due to larger proportion of more profitable lines being sold than was forecasted	271.76	
Net loss as above	$5091.93	

The above variations from the forecast are shown analyzed by the different lines of product and by individual items of product. An analysis of the loss of gross profits by lines as shown on form P is as follows:

LINE	TOTAL LOSS OF GROSS PROFITS	DUE TO CUTS IN PRICE	DUE TO INCREASE IN MANUFACTURING COSTS	DUE TO VARIATIONS IN VOLUME AND VARIETY
Planters	$2,154.93	$1,000.00	$374.93	$780.00
Cultivators	2,802.00	.....	400.00	2,402.00
Mowers	14.00*	210.00	142.00	366.00*
Pumps	174.00*	.....	126.00	300.00*
Repairs	197.00	.....	35.00	162.00
Misc.	126.00	.....	.....	126.00
Totals	$5,091.93	$1,210.00	$1,077.93	$4,136.00

* Signifies increase in profits.

[2] See MANAGEMENT AND ADMINISTRATION, December 1924, p. 607.

The gross profit variation sheet illustrated provides an analysis of the variations from the forecasted gross profits for all of the branches in total; separate sheets, however, can be used to provide an analysis of the variations from the forecasted gross profits of the individual branches. In the next instalment of this series the method of analyzing the variations in manufacturing costs by causes will be illustrated as also the complete analysis of the variation from the estimated net profits.

With this complete information before him the executive is in a position to answer fully the question "Where have my profits gone?" and it may be pertinently asked whether he should be satisfied with anything less than this full answer to the most important question he can ask himself regarding his business operations.

Analysis of Operations

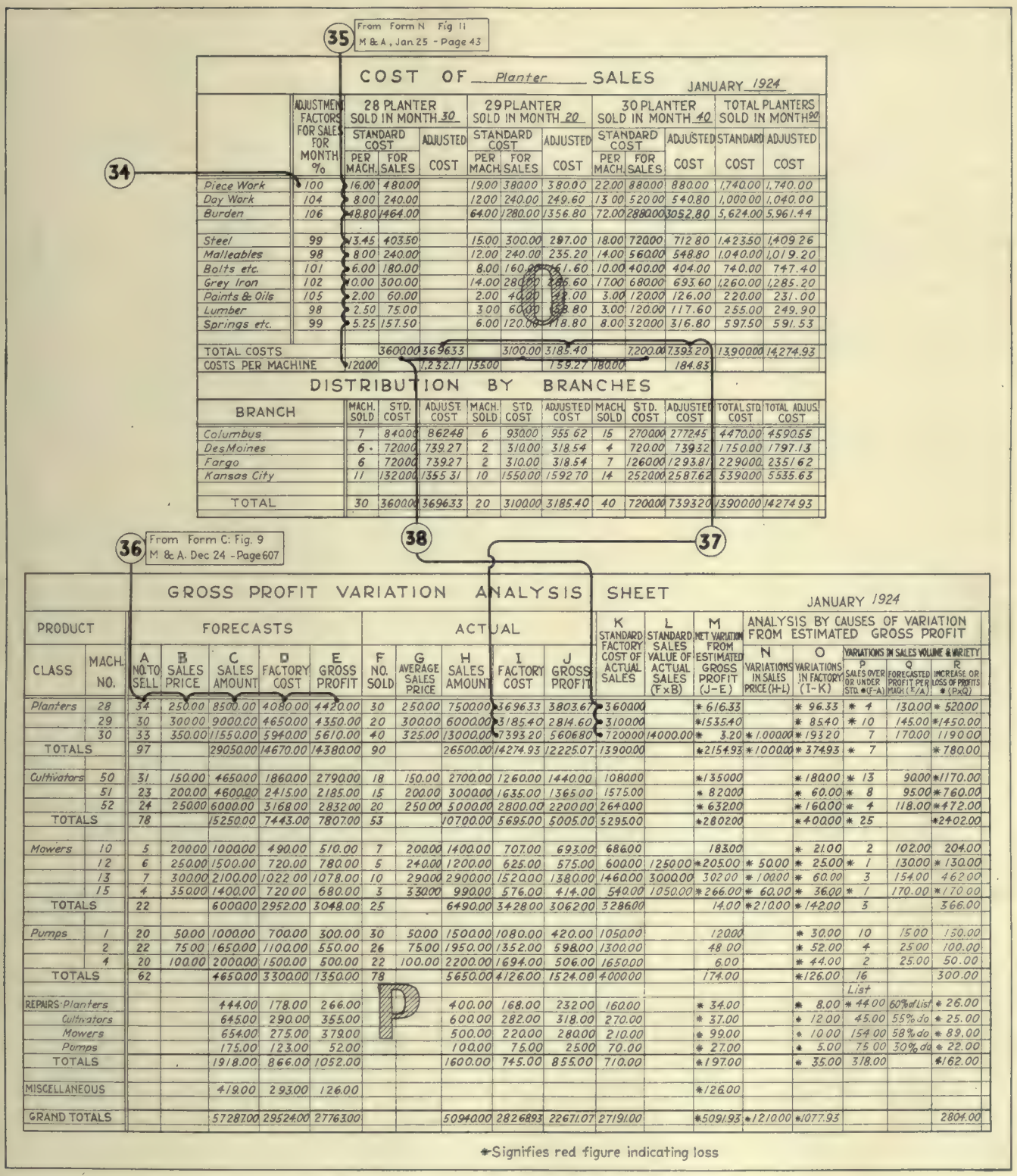
The following is a detailed explanation of the operations illustrated by the numbered lines on Fig. 12:

Line 34. Under the standard cost plan, the cost of the goods sold is obtained by figuring the standard cost of these goods analyzed by labor and burden and by main classes of material, these standard costs being adjusted to the basis of the actual costs by the use of adjustment factors. These adjustment factors are shown in the column headed "Adjustment Factors for Sales for Month" and the method of obtaining them will be illustrated in the next instalment of this series. The use of these factors is clearly shown on the diagram; for instance, the adjustment factor for malleable castings is shown as being 98 per cent, and the standard cost of the malleable castings in the sales of number 29 planters in the month is $240.00: multiplying $240.00 by 0.98 gives $235.20, which amount, representing the approximate actual cost of the malleables in the 29 planter sales, is entered as shown in the column headed "Adjusted Cost".

Line 35. As stated above, the approximate actual cost of the goods sold in the month is obtained by first determining the standard cost of these goods analyzed by classes of expense and then adjusting these standard costs to an actual cost basis by the use of separate adjustment factors for each of these classes of expense. Line 35 illustrates the posting to the cost of planter sales sheet of the standard cost of a number 28 planter, this standard cost data being obtained from the assembly standard cost sheet for this machine (see Form N on Fig. 11[3]). To obtain the standard costs of the machines sold in the month, it is necessary of course to multiply the standard costs per machine by the number of machines sold—for instance, the standard piece-work labor cost per machine of the number 29 planter is $19; 20 of these planters were sold in January, so that the total standard piece-work cost of these planters represents 20 × $19 or $380, as shown on the diagram.

Line 37. As already explained, the approximate actual cost of the machines sold in the month is obtained

[3] MANAGEMENT AND ADMINISTRATION, January 1925, p. 43.



35 From Form N Fig 11 M & A, Jan 25 - Page 43

COST OF Planter SALES JANUARY 1924

	ADJUSTMENT FACTORS FOR SALES FOR MONTH %	28 PLANTER SOLD IN MONTH 30			29 PLANTER SOLD IN MONTH 20			30 PLANTER SOLD IN MONTH 40			TOTAL PLANTERS SOLD IN MONTH 90	
		STANDARD COST PER MACH.	STANDARD COST FOR SALES	ADJUSTED COST	STANDARD COST PER MACH.	STANDARD COST FOR SALES	ADJUSTED COST	STANDARD COST PER MACH.	STANDARD COST FOR SALES	ADJUSTED COST	STANDARD COST	ADJUSTED COST
Piece Work	100	16.00	480.00		19.00	380.00	380.00	22.00	880.00	880.00	1,740.00	1,740.00
Day Work	104	8.00	240.00		12.00	240.00	249.60	13.00	520.00	540.80	1,000.00	1,040.00
Burden	106	48.80	1464.00		64.00	1280.00	1356.80	72.00	2880.00	3052.80	5,624.00	5,961.44
Steel	99	13.45	403.50		15.00	300.00	297.00	18.00	720.00	712.80	1,423.50	1,409.26
Malleables	98	8.00	240.00		12.00	240.00	235.20	14.00	560.00	548.80	1,040.00	1,019.20
Bolts etc.	101	6.00	180.00		8.00	160.00	161.60	10.00	400.00	404.00	740.00	747.40
Grey Iron	102	10.00	300.00		14.00	280.00	285.60	17.00	680.00	693.60	1,260.00	1,285.20
Paints & Oils	105	2.00	60.00		2.00	40.00	40.80	3.00	120.00	126.00	220.00	231.00
Lumber	98	2.50	75.00		3.00	60.00	58.80	3.00	120.00	117.60	255.00	249.90
Springs etc.	99	5.25	157.50		6.00	120.00	118.80	8.00	320.00	316.80	597.50	591.53
TOTAL COSTS			3600.00	3696.33		3100.00	3185.40		7200.00	7393.20	13900.00	14,274.93
COSTS PER MACHINE		120.00		1,232.11	155.00		159.27	180.00		184.83		

DISTRIBUTION BY BRANCHES

BRANCH	MACH. SOLD	STD. COST	ADJUST. COST	MACH. SOLD	STD. COST	ADJUSTED COST	MACH. SOLD	STD. COST	ADJUSTED COST	TOTAL STD COST	TOTAL ADJUS. COST
Columbus	7	840.00	862.48	6	930.00	955.62	15	2700.00	2772.45	4470.00	4590.55
Des Moines	6	720.00	739.27	2	310.00	318.54	4	720.00	739.32	1750.00	1797.13
Fargo	6	720.00	739.27	2	310.00	318.54	7	1260.00	1293.81	2290.00	2351.62
Kansas City	11	1320.00	1355.31	10	1550.00	1592.70	14	2520.00	2587.62	5390.00	5535.63
TOTAL	30	3600.00	3696.33	20	3100.00	3185.40	40	7200.00	7393.20	13900.00	14274.93

36 From Form C: Fig. 9 M & A. Dec 24 - Page 607

38

37

GROSS PROFIT VARIATION ANALYSIS SHEET JANUARY 1924

PRODUCT CLASS	MACH. NO.	A NO. TO SELL	B SALES PRICE	C SALES AMOUNT	D FACTORY COST	E GROSS PROFIT	F NO. SOLD	G AVERAGE SALES PRICE	H SALES AMOUNT	I FACTORY COST	J GROSS PROFIT	K STANDARD FACTORY COST OF ACTUAL SALES	L STANDARD SALES VALUE OF ACTUAL SALES (F×B)	M NET VARIATION FROM ESTIMATED GROSS PROFIT (J-E)	ANALYSIS BY CAUSES OF VARIATION FROM ESTIMATED GROSS PROFIT: N VARIATIONS IN SALES PRICE (H-L)	O VARIATIONS IN FACTORY (T-K)	VARIATIONS IN SALES VOLUME & VARIETY: P SALES OVER OR UNDER STD. *(F-A)	Q FORECASTED PROFIT PER MACH. (E/A)	R INCREASE OR LOSS OF PROFITS * (PxQ)
Planters	28	34	250.00	8500.00	4080.00	4420.00	30	250.00	7500.00	3696.33	3803.67	3600.00		*616.33		*96.33	* 4	130.00	* 520.00
	29	30	300.00	9000.00	4650.00	4350.00	20	300.00	6000.00	3185.40	2814.60	3100.00		*1535.40		*85.40	* 10	145.00	*1450.00
	30	33	350.00	11550.00	5940.00	5610.00	40	325.00	13000.00	7393.20	5606.80	7200.00	14000.00	* 3.20	* 1000.00	*193.20	7	170.00	1190.00
TOTALS		97		29050.00	14670.00	14380.00	90		26500.00	14274.93	12225.07	13900.00		*2154.93	* 1000.00	* 374.93	* 7		* 780.00
Cultivators	50	31	150.00	4650.00	1860.00	2790.00	18	150.00	2700.00	1260.00	1440.00	1080.00		*1350.00		*180.00	* 13	90.00	*1170.00
	51	23	200.00	4600.00	2415.00	2185.00	15	200.00	3000.00	1635.00	1365.00	1575.00		* 820.00		* 60.00	* 8	95.00	* 760.00
	52	24	250.00	6000.00	3168.00	2832.00	20	250.00	5000.00	2800.00	2200.00	2640.00		* 632.00		*160.00	* 4	118.00	*472.00
TOTALS		78		15250.00	7443.00	7807.00	53		10700.00	5695.00	5005.00	5295.00		*2802.00		*400.00	* 25		*2402.00
Mowers	10	5	200.00	1000.00	490.00	510.00	7	200.00	1400.00	707.00	693.00	686.00		183.00		* 21.00	2	102.00	204.00
	12	6	250.00	1500.00	720.00	780.00	5	240.00	1200.00	625.00	575.00	600.00	1250.00	*205.00	* 50.00	* 25.00	* 1	130.00	* 130.00
	13	7	300.00	2100.00	1022.00	1078.00	10	290.00	2900.00	1520.00	1380.00	1460.00	3000.00	302.00	* 100.00	* 60.00	3	154.00	462.00
	15	4	350.00	1400.00	720.00	680.00	3	330.00	990.00	576.00	414.00	540.00	1050.00	*266.00	* 60.00	* 36.00	* 1	170.00	*170.00
TOTALS		22		6000.00	2952.00	3048.00	25		6490.00	3428.00	3062.00	3286.00		14.00	*210.00	*142.00	3		366.00
Pumps	1	20	50.00	1000.00	700.00	300.00	30	50.00	1500.00	1080.00	420.00	1050.00		120.00		* 30.00	10	15.00	150.00
	2	22	75.00	1650.00	1100.00	550.00	26	75.00	1950.00	1352.00	598.00	1300.00		48.00		* 52.00	4	25.00	100.00
	4	20	100.00	2000.00	1500.00	500.00	22	100.00	2200.00	1694.00	506.00	1650.00		6.00		* 44.00	2	25.00	50.00
TOTALS		62		4650.00	3300.00	1350.00	78		5650.00	4126.00	1524.00	4000.00		174.00		*126.00	16		300.00
REPAIRS: Planters				444.00	178.00	266.00			400.00	168.00	232.00	160.00		* 34.00		* 8.00	List * 44.00	60% of List	* 26.00
Cultivators				645.00	290.00	355.00			600.00	282.00	318.00	270.00		* 37.00		* 12.00	45.00	55% do	* 25.00
Mowers				654.00	275.00	379.00			500.00	220.00	280.00	210.00		* 99.00		* 10.00	154.00	58% do	* 89.00
Pumps				175.00	123.00	52.00			100.00	75.00	25.00	70.00		* 27.00		* 5.00	75.00	30% do	* 22.00
TOTALS				1918.00	866.00	1052.00			1600.00	745.00	855.00	710.00		*197.00		* 35.00	318.00		*162.00
MISCELLANEOUS				419.00	293.00	126.00								*126.00					
GRAND TOTALS				5728.00	2952.00	2776.00			5094.00	2826.93	2267.07	2719.00		*509.93	*121.00	*107.93			280.00

*Signifies red figure indicating loss

FIG. 12 ANALYZING BY CAUSES LOSS IN GROSS PROFITS

by applying adjustment factors to the standard costs of these machines. Line 37 illustrates the posting of the actual cost of the sales of the three sizes of planters from the planter cost of sales sheet to the factory cost column of the gross profit variation sheet.

Line 38. In order to determine the variation from the forecasted gross profits, due to the actual factory costs being over or under the forecasted factory costs, it is necessary to figure both the actual and standard cost of the machines shipped in the month. This operation is performed on the gross profit variation sheet, and line 38 illustrates the posting to this form of the standard cost of the planter shipments from the planter cost of sales sheet.

The gross profit variation analysis sheet (Form P) shows the actual figures affecting the gross profits

actually earned in comparison with the forecasts, and then provides for analyzing the variation from the forecast according to the causes contributing to such variations. The method of figuring these variations is as follows:

Net Variation (Column M). This variation is obtained by deducting the figures in the forecasted Gross Profit column (column E) from the figures in the actual Gross Profit column (column J). For instance, the forecasted gross profits on planters were $14,380, whereas the actual gross profits realized were $12,225.07. Using our formula—net variation = J − E—we get the following result:

Actual gross profit (column J)	$12,225.07
Forecasted gross profit (column E)	14,380.00
Net loss in gross profits	$2,154.93

This amount of $2154.93, being a loss, is entered in the Net Variation from Estimated Gross Profits column (column M) in red.

Analysis of Price Variations

Variation in Price (Column N). Variations from the forecasted gross profits due to the machines being sold at prices different from those used in the forecast are obtained by the use of the formula H − L.

H represents the actual billed value of the machines sold in the month as entered in column H; L represents the forecasted sales value of the machines sold as entered in column L. For example, 40 of the number 30 planters were sold in the month at $325 apiece, whereas the forecasted profits were figured on the basis of a sales price of $350 apiece for these machines. The loss in gross profits due to this cut in price is therefore figured as follows:

Actual sales amount, 40 × $325 (column H)	$13,000
Actual sales figured at forecasted sales price 40 × $350 (column L)	14,000
Loss in gross profit due to price cut (column N)	$1,000

Variation in Factory Cost (Column O). Variations from the forecasted gross profits due to the actual manufacturing costs, being more or less than the forecasted (or standard) factory costs, are figured by the use of the formula K − I, where I represents the actual factory cost of the goods sold (as entered in column I) and K the standard or forecasted factory cost (as entered in column K). For example, the actual cost of the cultivators sold in the month as entered in column I was $5695, and the standard cost of these cultivator sales as entered in column K was $5295, so, applying our formula, we get the following:

Standard factory cost of cultivator sales (column K)	$5295.00
Actual factory cost of cultivator sales (column I)	5695.00
Loss of gross profit due to increase in factory cost (entered in red in column O)	$400.00

Variation Due to Volume and Variety (Column R). Variations coming under this head are figured by determining the number of machines sold under or in excess of the forecast and extending this shortage or excess at the forecasted rate of profit per machine. For instance, the loss of gross profits on the number 28 planter of $520 shown on the first line in column R is arrived at as follows:

Forecasted sales of 28 planters (column A)	34
Actual sales of 28 planters (column F)	30
Sales lost (column P)	4
Forecasted profit per machine (column Q)	$130
Arrived at as follows:	
Forecasted profit on 34 machines (column E)	$4420
Forecasted profit per machine, $\frac{4420}{34}$ (column Q)	$130.00
Loss of gross profits (column R), 4 (column P) × $130 (column Q)	$520

The total loss of gross profits due to variations from the forecasted volume of sales and percentage of sales of the different lines as shown in column R was $2804. To analyze this amount as between variations in volume and variations from the forecasted relationship between the sales of the different lines involves the following simple calculation:

Forecasted gross profit per cent of sales		48.46 per cent
Arrived at as follows:		
Forecasted gross profits (column E)	$27,763	
Forecasted sales (column C)	57,287	
Gross profit per cent of sales, $\frac{27,763}{57,287}$		48.46 per cent

Loss of gross profit due to loss of volume:	
Forecasted sales (column C)	$57,287.00
Actual sales (column H)	50,940.00
Loss of sales	$6,347.00
Loss of profits due to loss of volume, $6347 × 48.46 per cent	$3,075.76
Loss of gross profits due to volume and variety (column R)	2,804.00
Increase in gross profits due to larger proportion of more profitable lines being sold than forecasted	$271.76

The accountant student who is interested in the principles underlying the use of formulas for the analysis of variations in profits is referred to section 27 of "Management's Handbook," where the method of building up these formulas is explained in considerable detail.

This series "Working Plans for Profits" will be continued in the March number.

Factory and Foundry Accounting

Correct Costs at Little Expense—III

By GAYLORD G. THOMPSON

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THE small and medium-sized plant is faced with the necessity of knowing its costs accurately but at little expense. The methods used in a plant engaged in manufacturing plumbing goods, which have met this problem in a highly satisfactory manner, have been explained in these articles[1] up to the point where the cost clerk receives his notification of parts completed and delivered to stores. These deliveries may have been in the form of completed shop orders, or only partially completed orders. In the latter case, with each lot a part-order-sent-ahead form, or tracer card, is sent along, and the storeskeeper retains these slips until delivery is completed. Then he signs the slips and sends them to the cost clerk.

The cost clerk, upon receipt of the shop order cards or tracer cards, enters on each card the *factory cost* of the entire amount of goods shown as received by the stores clerk. The shop order cards are then turned over to the timekeeper as a notice that the orders are completed, as will be further explained under the subject of "Factory Order Costs". The cards are then filed until the end of the month, at which time a grand total is calculated which represents the total *credit* to Work-In-Process, and the total *charge* to Stores. This same method also applies to the pricing of requisitions except that the grand total represents *charges* to Work-In-Process and *credits* to Stores. These figures are given to the bookkeeper for ledger entries on the first of each month. This completes the entire function of charging and crediting for manufacturing distribution. The crediting of stores for the cost of goods sold will be explained under the subject of "Sales Orders".

Orders for Tool- and Pattern-Making

The issuing of orders for tool-making or pattern-making follows the same procedure as the issuing of factory production orders except that a different classification of order numbers is used. The materials used in the making of tools or patterns are entered on the order card by the tool-maker or pattern-maker, whichever the case may be. When the respective jobs are completed, the cards are turned in to the cost clerk for figuring the cost. At the end of the month the total cost of the materials used for tools and patterns respectively is given to the bookkeeper to credit to the Tool-Making Material account and the Pattern-Making Material account, respectively, after which the total cost of each group, including material and labor, is charged to the respective asset accounts. If tool numbers or pattern numbers are used, these numbers are inserted on the order card under the heading of "Part Number". When the respective jobs have been figured for costs, the cards are filed away according to numerical sequence of tool or pattern number, thus providing an inventory record of tools and patterns.

Factory Order Costs

In order to obtain costs and comparisons of costs, provision must be made for recording detail costs of each order completed by the shop. It is for this purpose that the order cost sheet shown in Fig. 8 is used. This order is filled out at the time that the shop order card is made up. The same information is written on this form as appears on the shop order card. The order cost sheet is kept on file by the timekeeper for making detail entries of labor records taken from the daily time tickets handed in each day by the various workers.

ORDER COST SHEET

Date 4-1-24 Patt. No. 30-P Part No. 30 Amt. 500 Order No. 2500

Name Straight valve body 1/2" Material Cast Brass

Date Finished 4-10-24 Pcs. Good 500 Pcs. Scrap none

Operations	Date	Order No.	Amt.	Man No.	Hourly Rate	Piece Rate	Total Labor Time	Unit Labor Time	Total Labor Cost	Unit Labor Cost
#1	4-2-24	2500	500	72	.40	1.00	10		5.00	.01
Bore & tap one end for 1/2" pipe.										
#2	4-3-24	2500	500	72	40	10⁰⁰	10		5⁰⁰	.01
Bore & tap other end for 1/2" pipe.										
#3	4-4-24	2500	200	37	.42	2⁰⁰	6		4⁰⁰	.02
Bore, face, seat, turn and thread for stem.	4-7-24	2500	300 / 500	37	42	2⁰⁰	9.5		6⁰⁰	.02
#4	4-5-24	2500	200	87	60	4⁰⁰	10		8⁰⁰	04
Polish	4-6-24	"	200	"	"	"	"		"	"
	4-9-24	"	100 / 500	"	"	"	5		4⁰⁰	"
#5	4-6-24	2500	200	77	.60	1⁰⁰	3		2⁰⁰	.01
Nickel buff.	4-9-24	"	100	"	"	1⁰⁰	1.25		1⁰⁰	.01
(Plate)	4-10-24	"	200 / 500	"	"	"	2.5		2⁰⁰	.01

FIG. 8 COST SHEET FOR FACTORY ORDERS

A daily time ticket is shown in Fig. 9, and the method of filling it out is readily seen. From this information the timekeeper makes his entries on the order cost sheet according to the operation performed. When the shop order card has been priced by the cost

[1] See MANAGEMENT AND ADMINISTRATION, November 1924, p. 517, and January 1925, p. 67, for previous articles.

clerk and turned over to the timekeeper, this is a notice that the respective order has been completed by the shop and that no further labor costs will be coming in on that order. The timekeeper then com-

DAILY TIME TICKET

Clock No. 72 Date 4-2-24

Name James Miller

Job No.	Part No.	Operation	Start / Finished	Total	Rate	Amount	Pieces
2500	30	1	7 00 / 5 30	10 hrs.			500
	Foreman						

FIG. 9 TICKET FOR TIME AND COST RECORDS

piles the totals as shown by the respective column headings appearing on the order cost sheet, and turns the sheet over to the cost clerk, who then makes entries in the ledger cost sheet as shown in Fig. 2,[2] previously explained. After these entries are made, the order cost sheet is then filed away according to the numerical sequence of order numbers, for possible future reference.

Sales Orders

When an order is received from a customer and has passed a credit rating, it is turned over to a clerk who sends out a card of acknowledgment and then makes out in triplicate what is known as the sales order, giving it an order number from the series assigned for this purpose. The original goes to the shipping clerk, the duplicate to the superintendent, and the triplicate to the cost clerk.

The shipping clerk obtains the goods from stores on presenting the sales order, which also acts as a requisition. After the goods are shipped, the original copy is given to the bookkeeper for billing and the cost clerk is notified of the shipment. The cost clerk then enters on his triplicate copy the *factory cost* of the goods sold. At the end of the month the totals are compiled and the figures given to the bookkeeper.

Another method of handling the original copy of the sales order after shipment has been made is to send the original copy to the cost clerk for the entering of *factory cost*, after which it is turned over to the bookkeeper for billing. This arrangement would do away with the necessity of providing a triplicate copy of the sales order, but places on the bookkeeper the burden of compiling monthly totals.

As stated before, the factory cost does not include general and administrative overhead. The general and administrative expenses incurred during the current month are applied in actual dollars and cents to the total factory cost of goods sold during that same month before profits are calculated. This arrangement insures greater accuracy in the calculations of profits than if the overhead percentage were used. The overhead percentage is used only when selling prices are calculated, and, when added to the *factory cost*, forms what is known as the *manufacturing cost*. Since the goods sold are drawn out of stores on the strength of the sales order, it is obvious that the factory cost of goods sold is also a credit to stores.

Partial Shipments

In the event that a partial shipment of an order is made, the shipping clerk checks off the items shipped, after which the copy of the order passes through the same routine as explained above. After the bookkeeper is through with the order, it is turned over to the order clerk, who immediately makes out another sales order for the balance of the goods to be shipped. The same order number is used but with the letter "A" affixed to denote that it is a sub-sales order for the balance of the goods appearing on the

FOUNDRY COST SHEET

January

Date	Materials Requisitioned: Ingots	Borings	Mch. Scrap	Supplies Requisitioned: Mold'g Sand	Core Sand	Oil (Pints)	Parting	Flour	Miscellaneous Requisitions: Date	Am't	Description	Unit Price	Total Price
1									1-13	16#	Antimony		2 00
2	1202	83			60				1-3	1	Roll toilet paper		.03½
3		444			110				1-3	25#	High temp. cement		1 38
4					70				1-4	5#	Box tin		2 45
5	1200				59				1-7	1	Lava Crucible		6 60
6						8	14		1-9	12½#	#12 Core Wire		48
7		565		387	120				1-11	52	Pcs. 1"x12"x18" Pgh. Lumber		5 25
8	1217	586			85			98#	1-12	2	rolls Toilet paper		16½
9				394	100	8			1-14	22#	High temp. cement		1 21
10					78				1-18	1	Lava Crucible		6 60
11	1215				95				1-23	12#	#16 Core Wire		87
12					115		32		1-25	1	gal. Pyramid oil		3.69
13									1-25	1	Lava Crucible		6 60
14	1187	546			160				1-28	50#	#3 Furnace Cement	0576	2 88
15					344	8			1-28	12#	Roll #16 Core Wire		81
16	1211			707	192				1-30	1	Quart wheel dresser		08
17	1186	576	103		142				1-30	3½#	Bar Tin		1 83
18				389	110	8							3945
19	1197												
20													
21			67		248								
22			26	550	190								
23	1217	544			110	8							
24	1124				60								
25	1109				170		31						
26													
27													
28	1111	550		839	120								
29	1112				115	8							
30					185								
31	1110	498		326	95								
Total	16398	4392	196	3592	3133	48	77	98			Total Payroll for Molders	595	81
Ave											" " " Coremakers	237	51
Mat. Cost	12	085	09	0009	.0045	.10	04½	026			" " " Indirect Labor	522	92
	$196776	$37332	$1764	$224	$614 10	$480	$2327	$250			" " " Complete	1356	24
	Total Cost Materials $2958.72			Total Cost Supplies, Etc. $67.36							Total Cost Materials and Supplies	$3386 63	
	Last Month $1909 78			Last Month $34 67							Last Month	$1944 45	

FIG. 10 FRONT OF FOUNDRY COST SHEET

[2] See MANAGEMENT AND ADMINISTRATION, January 1925, p. 67.

FOUNDRY COST SHEET

January

Date	Materials Melted: Ingots	Gates	Borings	Mch. Scrap	Fdry. Scrap	Total Melt	Furnace: Fur. No 1	Fur. No 2	Cored Castings Delivered	Solid Castings Delivered	Total Delivered	Fdry. Scrap
1												
2	358	345	97			800		4	606	511	1117	
3	446	436	118			1000	5		696	26	722	
4	178	174	48			400		2	487	37	524	
5	181	170	49			400	2		1076	95	1171	
6						1000						
7	459	421	120				5		77	421	498	
8	779	661	195			1635	5	3		23	23	
9	495	433	122			1050	5		8½		8½	
10	457	445	123			1025		5	163	6	169	
11	637	594	169			1400	7		387		387	
12	459	403	123			985	2	3				
13												
14	896	883	241			1970	7	3	1468½	587	2055½	
15	541	485	144			1170		6	606	204	810	
16	542	484	144			1170		6		87	87	
17	902	792	241	103	205	2243	3	7				205
18	542	453	145			1140	6		172	12	184	
19	618	583	169			1370	4	3	107		107	
20												
21	556	560	144	67		1327	6		565	64	629	
22	539	547	144	26	82	1338		6	1291	1138	2429	
23	634	596	170			1400		7	179	128	307	
24	883	522	195			1600		8	448	355	803	
25	1526	843	247			2635	7	6	598	358	956	
26												
27									156	156		
28	967	569	219			1755	8	6	40½		40½	
29	529	535	136			1200	6		1145	243	1388	
30	618	634	158			1400	7		312	328	640	
31	748	778	209			1735	7	2	861	2584	3445	
Total	15490	13295	3190	196	287	33148	87	77	11290	7313	18603	
Ave.												
Mat. Cost									.33	.207	.22	
									$2795.72	$1515.69	$4111.41	

Summary

Description		Cored Castings	Solid Castings	Total
Labor Cost				
Per Pound Delivered	Direct	.058	.032	
	Indirect	.028	.028	
	Total	.081	.060	
Costs				
Direct Labor		598.71	204.61	803.32
Indirect Labor		316.12	206.80	522.92
Materials		1433.83	924.89	2358.72
Supplies		42.91	24.45	67.36
Gas 247,500 cu ft		94.83	62.49	157.32
Prime Cost		2486.40	1450.24	3939.64
Depreciation Mchy.		22.81	18.76	51.57
Depreciation Bldgs.				
Overhead *		76.51	48.69	130.20
Total Mfg. Cost Deliv.		2795.72	1515.69	4111.41
Mfg. Cost per Pound Deliv.		.23	.207	.22

Name	Crucibles Used	Cost	No. of Heats per Cruc.	Pds. Melt per Heat	Gas Used per Heat	Gas Cost per Heat	Total Heats
Lava	1		49				
"	1		56	202	1509	.96	164
"	1		41				
(Last Month				301	1671	1.01	1444)

Remarks: * Overhead consists of light and Power ($29.00) Taxes ($12.43) Insurance ($9.23) 7% of fdy direct labor for general ($56.33) and Repairs ($10.42)

FIG. 11 BACK OF FOUNDRY COST SHEET

original sales order. This sub-sales order is termed a "back order" and is made out in the same manner as the original sales order. The number of times that an original sales order has been "back ordered" can be told by the extent to which the alphabetical sequence has been used.

If a sales order calls for special parts or combinations that are not made on a production basis, the shop uses the sales order number as a shop order to which all labor and material used on the order is charged. The costs are compiled in the same manner as the regular production orders except that no part numbers are used.

Foundry Costs

The foundry to which this particular cost system as outlined below was applied was found upon investigation to be turning out castings weighing from 3 oz. to 2 lb. This small variation in weight was a factor influencing the decision to base the cost of castings on the straight price per pound as the most expedient and simple method consistent with accuracy. Separate costs are kept, however, between cored castings and solid castings.

There are many arguments against the application of costs of castings on a cost per pound basis, one of them being that a plain casting reflecting a low labor cost to material cost would be excessive while a complicated casting reflecting high labor cost to material cost would not be a true cost, if a basis of a straight cost per pound were used.

However, the keeping of separate costs per pound on castings requiring cores and on castings not requiring cores is one step in overcoming this discrepancy. Then again, heavy castings require more melts than smaller castings to make an equal number of each. Large castings cannot be cleaned as quickly as smaller castings, and, finally, the extra amount of clerical work required to maintain constant detail records of the number of castings made per molder, and the amount of scrap made by each molder, to avoid overpayment of piecework earnings, with the consequent deductions and additions in cost records, is an added expense that would in many cases overshadow whatever accuracy might be gained in costs by having detail records. Especially is this true in a small plant where overhead must be kept as low as possible consistent with production and profits. It must be remembered that minute detail records of foundry costs do not reduce costs, but only allocate costs in proportion to the type of casting made.

Where castings are produced that range in weight from 3 oz. to 300 lb. each, the application of costs on a straight price per pound basis would be a fallacy. Detail cost records of each casting would then be a necessity unless the alternative is used by creating a classification of weights and applying a straight cost per pound to each classification.

The foundry cost sheet form shown in Fig. 10 and the reverse side of this form shown in Fig. 11 show methods that have proved very accurate in the compilation of brass foundry costs on the straight price per pound basis. Castings with sand cores are known in this instance as "cored castings," while castings which require no making of cores are, for convenience, called "solid castings".

The method of issuing foundry orders is the same as the method described in the issuing of shop or factory orders.[3] The same shop order card is also used, the only difference being the use of a special series of order numbers. The delivery of castings to the stores is handled in exactly the same manner as the delivery of finished materials from the shop to the stores as explained in the paragraphs on the issuing of factory orders.

It will be noted that one side of the form shown in Fig. 10 is used exclusively for recording all materials and supplies charged to the foundry, while the

[3] See MANAGEMENT AND ADMINISTRATION, January 1925, pp. 69-70.

reverse side, Fig. 11, is used for production records and costs. The entries as made in Fig. 10 are taken from requisitions issued by the foundry during the month.

The entries made in Fig. 11 under the column headings "Cored Castings Delivered" and "Solid Castings Delivered" are taken from the foundry order cards previously checked in by the stores clerk. Only the total weight of the castings received each day is entered in the respective columns.

The columns appearing in the section headed "Materials Melted" receive their respective entries from the foundry foreman's record of daily melts, materials used, and furnace heats.

Calculation of Total Foundry Costs

Summary of Costs. In the summary section, the direct labor is regarded as molders and coremakers, and the indirect labor as furnace tender, helpers, cleaners, and the foreman. "Materials" represents the charges to the foundry for the month and is the figure representing the total appearing at the bottom of Fig. 10, namely $2358.72. The supplies charges are likewise transferred. Depreciation charges are taken from the office records, also the overhead charges.

Allocation of Direct Labor Costs. The first procedure is to determine the actual direct labor cost per pound of castings *delivered.* Care must be taken that the labor cost of coremakers is not reflected in the cost per pound of solid castings. To guard against this, the total pay-roll of *molders* only is divided by the combined total number of pounds of both the cored and solid castings delivered. The figure thus derived is the direct labor cost per pound for solid castings, but represents only the molding cost per pound of cored castings. The cost per pound for coremaker labor is then calculated by dividing the total pay-roll for coremakers by the total number of pounds of cored castings delivered. This figure, when added to the molding labor cost per pound, represents the direct labor cost per pound of cored castings.

Allocation of Indirect Labor Costs. No separation of costs is necessary in figuring indirect labor charges on cored and solid castings. The total pay-roll of indirect labor divided by the combined total weight of all castings *delivered* represents the indirect labor cost per pound of casting. This figure when multiplied by the number of pounds of cored castings delivered, is the total charge to cored castings for indirect labor. The difference between this charge and the total indirect labor pay-roll is the indirect labor charge to solid castings.

Allocation of Material Charges. In the distribution of material charges, a method must be used that is consistent with the general procedure of this system of cost calculations. It resolves itself into the simple process of applying the cost of materials (not including supplies) requisitioned by the foundry to represent the material cost of the castings delivered by the foundry, irrespective of the price per pound. For example, if the foundry received 20,000 lb. of brass ingots at 12 cents per lb., costing a total of $2400, and produced 18,000 lb. of castings, the material cost of $2400 would be charged to the 18,000 lb. delivered, bringing the raw material cost per pound up to 13⅓ cents. This would then be the *material* cost per pound charged to the castings *delivered* by the foundry. In practice, the difference as reflected in the above example is not so great, but works on a closer margin, in fact, close enough to be considered as allowance for shrinkage.

Where a foundry requisitions enough material to meet the requirements of several months' production, it will be necessary to keep additional records of materials actually used. In a small foundry, however, the requisitions for materials charged to the foundry can easily be regulated to meet actual requirements for each day or month.

The figure evolved by determining the raw material charges per pound as outlined above, multiplied by the total number of pounds of cored castings *delivered,* equals the material charge to cored castings. The same method of figuring also applies to solid castings. The sum of these two totals should be the same as the total cost of materials requisitioned by the foundry during the month.

The allocation of supplies charges, fuel charges, depreciation, and overhead is distributed over cored castings and solid castings delivered, in practically the same way as described under the subject of "Allocation of Material Charges", after which final conclusions as to costs are easily ascertained.

It might be well to mention here the element of credits and charges affecting borings. In this instance the borings are credited to Work-In-Process only at the time when they are requisitioned by the foundry. This saves considerable time and is of more convenience than when credit slips are made out every time a delivery of borings is made by the shop to the storeroom.

Another method is to ignore the charges of borings to the foundry and charge the foundry for only the virgin material. This would automatically reflect a lower cost in the castings and bring about the same results as if the cost of borings were actually charged and credited to the respective accounts. A record of the amount of borings used must at all times be kept, whether figured in costs or not.

Conclusion

As explained in introducing the material presented in these articles, it is necessary for the smaller plant to forego many of the elements which are valuable and necessary in the cost accounting system of a large organization. Up to reasonable limits, increasing outlay of money for accurately determining costs produces economy when manufacturing operations are conducted on a large scale, but highly refined methods often become mere red tape in a smaller concern. The system outlined here has, in actual operation, supplied costs so close to correctness that further expense in gathering and analyzing data would have added little, if anything, to the annual profits of the concern where they were installed.

Hydro-Pneumatic Sand Blast

IN using sand blast for cleaning purposes, the dust and fine sand blown into the air make the job disagreeable and usually force the operators to wear masks. A method by which this disagreeable feature is eliminated and, at the same time, the cutting power of the sand increased is to add water to the cutting sand.

A special blasting gun having three inlets is necessary. Through the foremost inlet, sand is delivered in the usual manner. Through the second inlet, water under considerable pressure, possibly 125 lb., is delivered. The rear inlet delivers compressed air.

In operation, the sand is forced out as a wet mixture which, apparently, has greater cutting power

FIG. 1 PORTABLE HYDRO-PNEUMATIC SAND BLAST OUTFIT

than dry sand. The principal advantage is, however, that there is no dust blown into the air, and the sand, together with the removed material, is carried away by the water, leaving the surface worked upon free from all debris which might hinder the operator in seeing how the work is progressing.

Controlling Furnace Temperatures

By R. H. Mac GILLIVRAY

Westinghouse Electric and Manufacturing Company

IN the manufacture of wire to be used for shade roller springs, a final process of hardening and tempering under positive heating control is necessary for best results. Heat treating has usually been done by hardening the wire in cast-iron lead pots, quenching it in an oil bath and drawing it in other lead pots. These pots, when heated by producer gas, varied as much as 25 deg. fahr. plus or minus from standard, so that satisfactory results were difficult to produce.

About a year ago the Stewart Hartshorne Company installed a Westinghouse electric furnace. It consists of two units—an electrically heated air hardening furnace about 18 ft. long and an electrically heated lead drawing pan. Quenching is done in oil as before. The hardening furnace has a nickel-

FIG. 1 DISCHARGE END OF FURNACE—WIRES ENTERING OIL BATH

chromium retort 13 in. wide, 2½ in. high, the full length of the furnace. Insulating material fills the space between the retort and the furnace shell. The lead pan is similarly insulated except at the top, which is open.

The process is continuous. From 10 to 32 strands of wire, depending on their size, are run through the furnace, Fig. 1, quenched in oil, and drawn in the lead pan, Fig. 2. Speed of travel ranges from 36 to 48 ft. per min. Temperature control is automatic. The furnace is divided into three 6-ft. sections, each of which is controlled by electric pyrometers. Temperature in the first two sections is kept at 1800 deg. fahr., the exit section at 1650 deg. fahr., and the lead pan 710 deg. fahr. Overall operating consumption for both units on continuous operation is 48.5 kw-hr.

In this plant current is furnished the heat-treating department for 2 cents per kw-hr. for furnace operation. At this rate fuel costs are 26 cents per 100 lb.

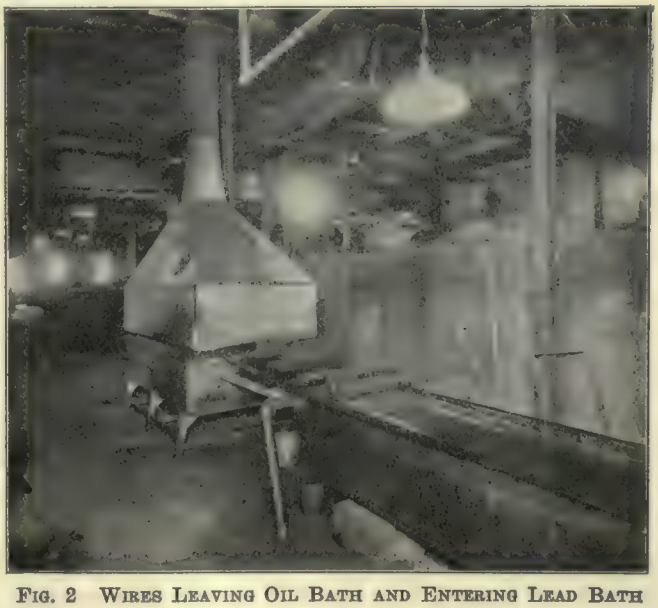


FIG. 2 WIRES LEAVING OIL BATH AND ENTERING LEAD BATH

wire, and labor and fuel costs 53 cents per 100 lb. wire. With the gas furnace formerly used, these costs were, respectively, 38.1 cents and 85.8 cents, showing a saving of 32.8 cents per 100 lb. wire, for fuel and labor cost of production when using the electric furnace.

Temperature variation in the electric furnace is not greater than 2½ deg. fahr., so that rejections have been practically eliminated although it has about twice the production of the gas furnace.

Plant Bus Service

THE manufacturing department located at the lower end of the main avenue of General Electric Company's Schenectady Works is very close to one and one-half miles from the general offices and engineering buildings at the other end of the works.

In the course of each day's work, constant interchanges of ideas and papers, which cannot be handled satisfactorily through the mail or over the telephone, are necessary. The great extent of the plant, however, would render much of these movements impracticable if walking had to be resorted to in every case. To eliminate this difficulty, the company has installed a passenger bus that connects the two extremes of the main avenue with 15-minute service.

The bus is electrically operated and, except for the driver's wages, the cost of operation is almost negligible. It holds 14 passengers comfortably seated, but, at starting and quitting time, when it is utilized by employees using an entrance at the lower end of

FIG. 1 SCHENECTADY WORKS PASSENGER BUS

the plant, it has been known to carry 30 passengers, not, however, with quite so much comfort.

The service is free to everyone within the plant. Workmen use it when going to distant jobs or to the offices. Office men use it on their trips to the shops. Visitors use it to get to their destinations. Messenger boys use it to expedite delivery of their messages.

The amount of time and energy saved by the use of this bus is impossible to estimate, but the company is quite sure that the small cost of its operation and maintenance is greatly overbalanced by the value of the savings made possible by it.

Unique Works Contest

IN order to keep up the interest of employees in their work, the Baltimore Works of the General Electric Company operates a unique contest. The plant has been divided into 28 sections and each section is rated monthly on the degree of perfection it has attained in six fields of activity. These fields,

FIG. 1 CONTEST TROPHY FOR WHICH TWO DEPARTMENTS TIED

together with the weight given each in the determination of the total, are as follows:

1. Workmanship	Maximum	credit	30
2. Promises kept	"	"	25
3. Economy	"	"	15
4. Good housekeeping	"	"	10
5. Attendance, punctuality	"	"	10
6. General deportment	"	"	10

The character of workmanship is judged by inspectors' reports, complaints, and by the records of errors on cases of negligence. Keeping of promises is judged by the proportion of overdue items on the schedule. Economy is judged by the low cost of operations, elimination of waste and rejected material and other losses, reduction of expense items, such as telephone, stationery, supplies, etc.

Good housekeeping is judged by the general orderliness and cleanliness of each section. Attendance and punctuality is rated from time cards in the obvious manner. General deportment is judged by the degree of attention and thoroughness with which employees do their work, by the precision with which instructions are carried out, by the manner in which all rules and regulations are observed and by the interest which individual employees take in their work.

Six committees are appointed, each one of which rates all sections monthly for one qualification. These ratings are then collated and the winning section becomes the possessor of a large loving cup (Fig. 1) until it is won by another section during subsequent months. At the end of the contest year the previous twelve monthly ratings are consolidated and a permanent bronze tablet, inscribed with the year

and the name of the foreman and department, presented to the leading unit as a permanent record of its success. A watch fob or some other memento, suitably inscribed, is presented to each individual in the leading department.

Because awards are made monthly, and because the cup with its case makes an imposing exhibit in any department and invites comment from all who see it, it serves to keep all employees interested in the contest. This plan has been in operation since July 1922, but the monthly reward still arouses as much, if not more interest than the first one. That it has resulted in an improvement in the plant is evidenced by a comparison of ratings. Early in 1923 the average plant rating was slightly over 67 on a basis of 100; June 1924 rating was nearly 76. This average was made up of individual averages ranging from 86 for the blacksmith shop, which, incidentally, has taken first place in yearly averages twice and second place the other year, down to 59.

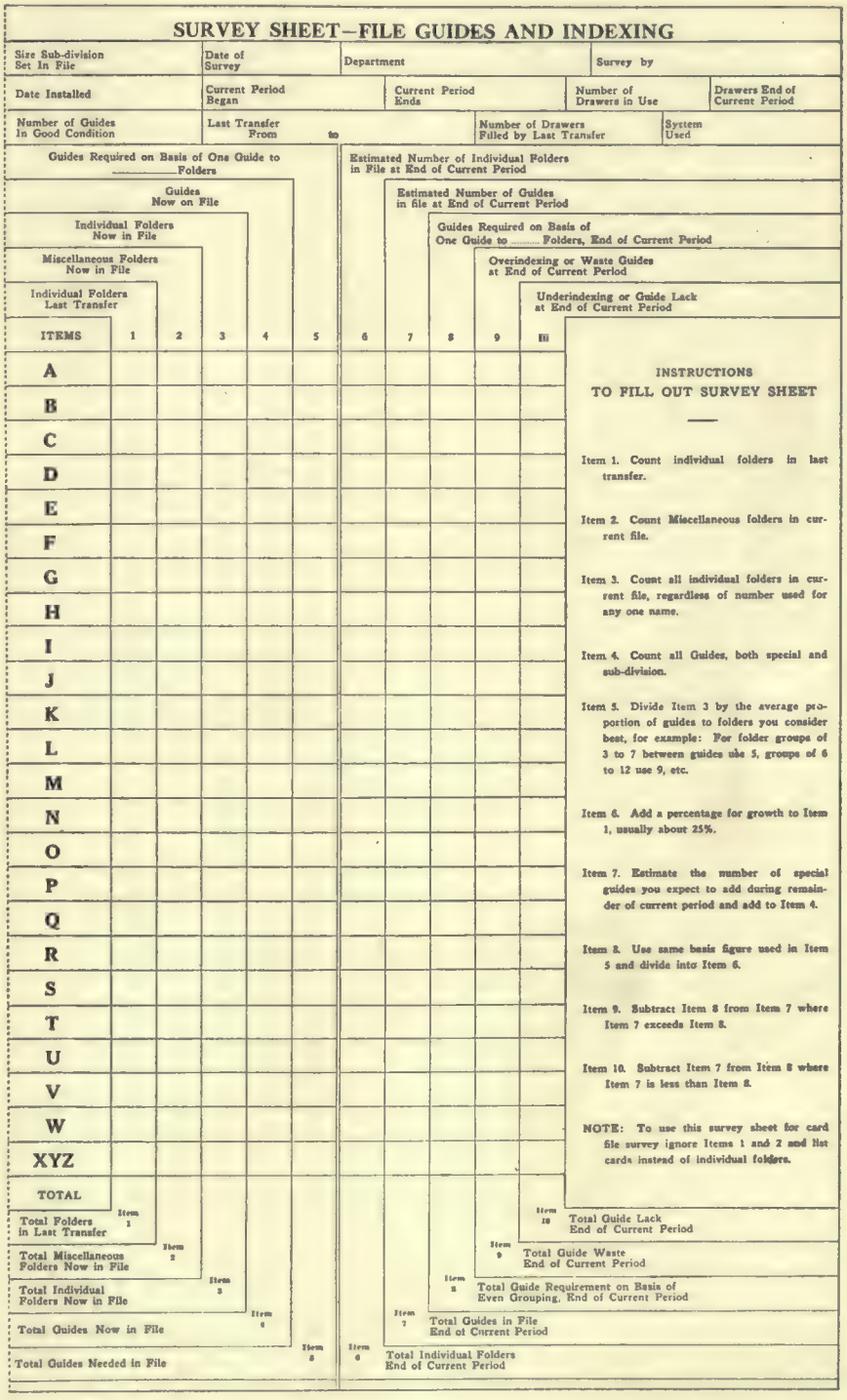
The group depicted in the illustration is that of the tool and die department which on one occasion was tied for first place with the blacksmith shop. The tool and die department at that time being in possession of the cup, the two departments decided to resort to the expediency of flipping a coin to determine who should retain the trophy for the ensuing month, the blacksmith shop being successful in the toss.

File Survey Sheet

THE accompanying form is a survey sheet for determining the efficiency of filing systems. It was prepared by the Aluminum Company of America, and its particular purpose is to show whether guide or index cards are being used effectively.

The composite result of many surveys showed that usual filing installations were inefficient. Too many miscellaneous folders were used, thus encouraging neglect in the use of individual folders, and files often contained more than half as many guide cards as folders. By use of a chart like the one shown, it is possible to determine readily the relative rating of any installation in regard to most economical and efficient utilization of guide cards and folders.

File indexing has been based usually on alphabetic subdivision guides produced in sets. From their investigations the Aluminum Company believes such a system of indexing cannot be efficient for the following reasons: (1) A set of alphabetic subdivision guides will not fit a file except at the end of the current filing period; (2) no formula of guides per drawer, letter or name can operate at all times when file matter is cumulative; (3) alphabetic subdivisions cannot be computed from a general list of names and be economically applicable to any one list; (4) subdivisions cannot be expanded without decreasing value of old guides.



SURVEY SHEET—FILE GUIDES AND INDEXING

Size Sub-division Set In File | Date of Survey | Department | Survey by

Date Installed | Current Period Began | Current Period Ends | Number of Drawers in Use | Drawers End of Current Period

Number of Guides In Good Condition | Last Transfer From ... to ... | Number of Drawers Filled by Last Transfer | System Used

Guides Required on Basis of One Guide to _____ Folders

Guides Now on File

Individual Folders Now in File

Miscellaneous Folders Now in File

Individual Folders Last Transfer

Estimated Number of Individual Folders in File at End of Current Period

Estimated Number of Guides in file at End of Current Period

Guides Required on Basis of One Guide to ..... Folders, End of Current Period

Overindexing or Waste Guides at End of Current Period

Underindexing or Guide Lack at End of Current Period

ITEMS	1	2	3	4	5	6	7	8	9	10
A										
B										
C										
D										
E										
F										
G										
H										
I										
J										
K										
L										
M										
N										
O										
P										
Q										
R										
S										
T										
U										
V										
W										
XYZ										
TOTAL										

Total Folders in Last Transfer — Item 1

Total Miscellaneous Folders Now in File — Item 2

Total Individual Folders Now in File — Item 3

Total Guides Now in File — Item 4

Total Guides Needed in File — Item 5

Total Individual Folders End of Current Period — Item 6

Total Guides in File End of Current Period — Item 7

Total Guide Requirement on Basis of Even Grouping, End of Current Period — Item 8

Total Guide Waste End of Current Period — Item 9

Total Guide Lack End of Current Period — Item 10

INSTRUCTIONS TO FILL OUT SURVEY SHEET

Item 1. Count individual folders in last transfer.

Item 2. Count Miscellaneous folders in current file.

Item 3. Count all individual folders in current file, regardless of number used for any one name.

Item 4. Count all Guides, both special and sub-division.

Item 5. Divide Item 3 by the average proportion of guides to folders you consider best, for example: For folder groups of 3 to 7 between guides use 5, groups of 6 to 12 use 9, etc.

Item 6. Add a percentage for growth to Item 1, usually about 25%.

Item 7. Estimate the number of special guides you expect to add during remainder of current period and add to Item 4.

Item 8. Use same basis figure used in Item 5 and divide into Item 6.

Item 9. Subtract Item 8 from Item 7 where Item 7 exceeds Item 8.

Item 10. Subtract Item 7 from Item 8 where Item 7 is less than Item 8.

NOTE: To use this survey sheet for card file survey ignore Items 1 and 2 and list cards instead of individual folders.

FIG. 1 SURVEY SHEET FOR DETERMINING EFFICIENCY OF FILING SYSTEMS

THE EDITORS' PAGE

Great Steps in Management

THE greatest and most important effect of this movement [management] is that it has made men think as never before as concerns all phases of productive industry." In this sentence, Dean Kimball in his article on page 113 of this issue places his finger upon the great contribution that management has made. Far above the value of the methods, systems and economies which management engineers have devised, stands the thinking that the managers of manufacturing industry have done as a result of the management movement.

This thinking has had four great branches, or has run through four broad channels.

Taylor's teachings and applications dealt with production control. The fundamental nature and soundness of his principles are proved beyond question by their application in ways in which he could not have foreseen. Many of his mechanisms have been discovered to be of universal application and are now widely accepted. In fact, Taylor's entire philosophy of preplanning in advance of execution is now accepted as good management.

Production control, therefore, stands in point of time as the first of the four great channels along which management thinking has flowed. The other three have developed since Taylor's death: personnel administration, operating control through accounting, financial management.

Personnel administration came with a great surge during and immediately following the World War, and has since settled back to a recognized place of importance and value in the management of manufacturing industries. It has been a great humanizing development and has introduced a most promising element into industrial operation.

Operating control through accounting is a great contribution from the accounting profession. The engineer's point of view—estimating or predicting future results, evaluating the possibilities of methods, and necessary accomplishments—has been adopted, so that now the accounting and comparing functions assist operation. This development has come through a break with accounting tradition, a subjection of the philosophy of historical accounts and the acceptance of the newer point of view of accounting which predicts results and measures by recorded experience.

The fourth of these branching developments is financial management, which has found its highest expression through the theory, principles and practice of budgeting. This, again, is an outgrowth of the scientific attitude.

As a result of this thinking, this experimenting and application of modern management, we now have, as Dean Kimball forcefully states, a body of "recorded knowledge, classified and proved by experience to be trustworthy as a basis of future performance." Such is the contribution which modern management has made during the last 20 years to aid and further the work of the manager and executive.

Equipment Economy

WRITING elsewhere in the present number of MANAGEMENT AND ADMINISTRATION, Mr. Franklin describes the attitude of the average industrial manager to his machinery and equipment:

> The executive mind desires to see it produce, to earn on its investment; hates to see it discarded as long as it is able to do what it was originally designed to do; feels that to replace it before replacement was expected or before it has outlived its usefulness is to waste its investment.

And he then pictures the consequences:

> As a result, especially in the older industrial centers, there are many manufacturing units operating casually with ancient outfits unable to meet the competition of newer districts or newer minds, struggling along without growth because of high costs and restricted profits, or frequently with no profits. . . . Eventually they will be forced to choose between rehabilitation or cessation.

The accuracy of the picture Mr. Franklin draws will not be questioned. But what is true economy when it comes to the replacement of equipment? When shall the manufacturer lay the old aside? Shall the well-tried and smoothly operating machine go into the discard simply because it is old? Shall the new machine be scrapped merely because there is a still newer machine on the market?

Fortunately with machinery, sentiment, so frequently a disturbing element in adjusting the human relations of industry, does not enter. The whole matter is purely one of "deliverng the goods," and the only problem is to discover the point when the best delivery of the goods demands the replacement of existing equipment. This issue Mr. Franklin meets squarely, showing the conditions that the manufacturer must meet if he is to face competition and stay in business, and suggesting a formula for determining just when these conditions demand replacement or change of existing equipment.

It is to be noted that even where competition does not demand replacement or change of equipment, the requirements of good industrial operations may and frequently do. If the existing equipment is not delivering the goods at the lowest possible cost—quality considered—there is an economic waste. The manufacturer may be able to meet competition in spite of this loss, but nevertheless if it is at all material it cannot be ignored. In other words, if profits that might be made are not being made, it is as truly a loss as if cash actually in

hand were stolen, needlessly expended, or otherwise dissipated. The wise manufacturer will not wait till competition closes around him to discover and correct any unnecessary loss.

Reduce Your Shipping Cost

DISTRIBUTION costs are too high. They must be lowered, as production costs have been lowered, if American manufacturers and the buying public are to receive full benefit from the industrial progress that has been made during the last score of years. The same methods will have to be applied to this problem as those which have made the industries of this country foremost in efficient production processes.

The reasons for the great difference between manufacturing cost and what the ultimate consumer must pay for an article are manifold. Much study will be necessary before any principles or methods can be developed for regulating or co-ordinating the activities of the many interests involved in changing the utility of a bit of iron ore, for instance, so that it may be used to nail the heels on a pair of shoes. The solution of this problem promises to be more difficult than any yet undertaken in the management field.

The first organized effort toward its solution is being made as this issue goes to press. Under the auspices of the United States Chamber of Commerce, some 150 of the country's leading distributors, business men, and economists are meeting at Washington to discuss the reasons why half of the ultimate consumer's buying dollar is required to pay distribution costs.

There are two ways in which every manufacturer can reduce his own distribution costs. In the movement of material from mines to manufacturing plants, and from manufacturing plants to distributors, there is always present the item of transportation costs and usually an item covering loss and damage of the product in transit.

These costs increase the price the manufacturer must pay for his raw materials and the price he must charge for his finished product. Any reduction in these cost items is directly reflected in lower cost of his product and subsequent increase in percentage of profit or decrease in selling price.

In Robert T. Kent's article, appearing in this issue, are given a number of definite practical suggestions for reducing freight costs. The article by Dirk P. De Young gives valuable information, based on mature shipping experience, concerning proper packaging methods to reduce shipping costs.

The only preparation necessary, the only "system" or management mechanism needed to make substantial savings in shipping costs is, in one case, a study of freight rates and schedules, and in the other, a common-sense analysis of the packaging requirements for the product to be shipped.

The information gained from such studies and applied as suggested in the articles will be first, but important, steps toward reduction in distribution costs. No business should fail to take advantage of the opportunity offered by the methods suggested.

Using the Other Man's Experience

THE man who is charged with the practical operation of a manufacturing plant can no longer be expected to have definite, first-hand experience in all branches of the work that he has to run. His assistants are in many cases more proficient, each in his own line, than the manager himself.. But if the manager is really going to handle his job properly, he must know a great deal in a general way about the work in which these assistants are responsible for producing results. Otherwise, how can he direct and co-ordinate all departments for the ultimate good of the entire organization?

Very few plants are so fixed that they have either the time or the money to experiment and develop new equipment and new methods in all of their divisions and departments. In one or two, perhaps, they can do pioneer work. The products of the plant may reflect extensive research and industrial progress made by the company on its own account. But the majority of operations in manufacturing, material handling, making and using power, planning building layouts, dealing with employees, purchasing, stores-keeping, accounting, running an office, and all other activities under the direct say-so of the plant executives, must be conducted along lines which someone entirely outside of the organization has at some time worked up, tried out, and proved eminently successful.

After all, only a small percentage of the methods of work in any one manufacturing plant is new and original with that plant. All the rest have been picked up from only two sources—personal acquaintance with men who have done things in other plants, and reading about these things in the pages of reputable magazines and books.

The time and money which managers save by utilizing such sources of information, and thereby avoiding useless and costly experimenting along lines which have already been thoroughly and successfully worked out by someone else, run up into enormous amounts. Undoubtedly they overtop even the huge savings brought about by the elimination of waste of materials.

But, of course, in his reading the manager must exercise judgment. Only a small amount of fact matter has been established as incontrovertible and immutable. A great deal is advanced as fact matter which is really only personal opinion with a plausible appearance of fact. The busy manager must rely upon the magazines and books which he reads, to weigh the material presented, sort out the reliable data, present it without padding or without bias, express it in plain, straightforward language, prepare it for direct, ready use, and have the courage to break away from conventional practice when the sound value of new ways and new devices is indisputably demonstrated.

Remove this source of information from the reach of manufacturing plants and you have cut the lines of intercommunication in industry so completely that the whole industrial structure will be jeopardized. No plant can live entirely to itself. It must take in information from this source—and give some out. The real fact-story of the other man's experience is the cornerstone of definite and rapid industrial progress.

INDUSTRIAL EQUIPMENT
NEWS FOR THE MANAGEMENT

This department is conducted to give our readers essential facts regarding items of industrial equipment recently placed on the market, that may be used to increase production or lower costs. The editors will be glad to furnish additional information about any item. All information given is obtained from reputable manufacturers, and MANAGEMENT AND ADMINISTRATION accepts it as reliable.

Safety Collar

A MALLEABLE iron safety collar intended to maintain the proper alignment of such equipment as pulleys, shaft bearings, hangers, etc., has been developed by Link-Belt Company. Strength, toughness, durability, and light weight have all been incorporated in this new device.

It is so designed that it can be split into two pieces, making installation or adjustment easy. It can be furnished

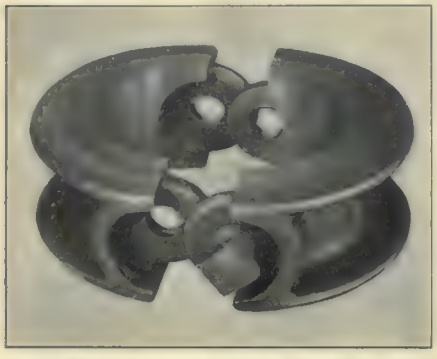


FIG. 1 MALLEABLE IRON SAFETY COLLAR

in the solid ring type if desired. Both types are machine-finished and possess considerable wear- and rust-resisting qualities which permit their use in installations where atmospheric conditions or abrasiveness would cause excessive deterioration. In tests, the collars have stood up well under shocks and strains encountered in heavy-duty service.

Circuit Breakers

A CIRCUIT breaker designed to replace switches and fuses on motor and feeder circuits has been developed recently. It is a double-pole "interlocked trip" type. The two poles are closed independently and successively. The pole first closed will open when the second pole is closed if an overload exists, and both poles open simultaneously on an overload.

For installations where there is excessive vibration or where circuit breakers are subjected to mechanical shocks of such intensity as to cause undesired openings, "shock-proof" attachments have been developed. Roller-Smith Company, manufacturers of both the circuit breaker and "shock-proof" attachments, can supply the latter for any of their standard-type breakers.

Coal Meter

A DEVICE for measuring the amount of coal fed into each boiler or stoker has recently appeared on the market. It is guaranteed accurate within 2½ per cent under normal working conditions, can be accommodated to any type of chain grate stoker, eliminates errors due to moisture, and is easy to install.

The device consists of mechanism which changes the product of grate speed and size of coal opening to a volumetric basis. From many tests, it has been proved that equal volumes of any coal weigh the same within 2 per cent, so the volumetric reading can easily be changed to give an accurate indication of the weight of coal burnt. This device is manufactured by Republic Flow Meters Company.

FIG. 1 COAL METER

Small Electric Furnace

THE Westinghouse electric tube furnace meets the demand for a small, economical electric furnace for general use in the laboratory or experimental room. It is useful for heating small soldering irons and making tools and laboratory instruments and equip-

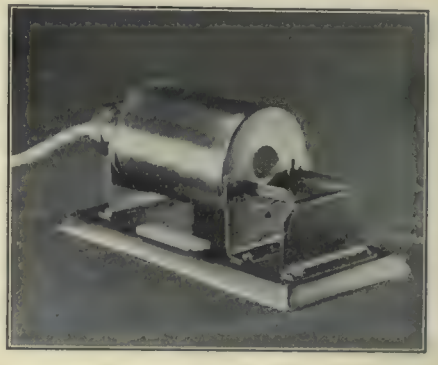


FIG. 1 SMALL ELECTRIC FURNACE

ment. There are no air currents to disturb the contents, and in every way it is well suited for the chemical laboratory. Although the continuous safe operating temperature is 1600 deg. fahr., 1850 deg. may be safely attained for short time operation.

The furnace is constructed of a one-inch porcelain muffle around which is wound the heating element of nickel-chromium wire. The refractory tube is insulated with high-grade moulded insulation, and the whole protected with a sheet metal shell. The furnace is supplied with a cord and plug attachment so that it can be connected to an ordinary lamp socket.

Portable Riveter

FOR light riveting and punch work, especially where a compact machine is needed to reach out-of-way places, and for use with special tools for crimping wire, upsetting, etc., Hanna Engineering Works has developed a pneumatic machine. It can be mounted or suspended to operate in any position to suit the work.

It is made in three sizes ranging from 7 to 9 in. reach, from 7 to 8 in. gap, from 6 to 15 tons rated pressure,

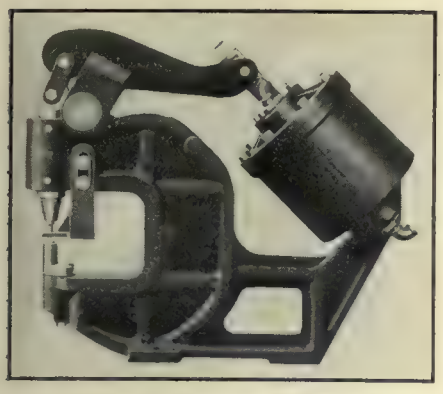


FIG. 1 PORTABLE RIVETER

from 300 to 625 lb. weight, and from ¼ to ½ in. hot rivets, 3/16 to ⅜ in., cold rivets.

Automatic Fire Extinguisher

FIRE protection for tanks of naptha, gasoline, benzine, and other inflammable materials used in dipping, cleaning, quenching, spraying, and similar operations, is provided by Model R T Automatic Foamite Extinguisher. At the first flash of fire, the device is operated by a Lowe Release, and within one minute 100 gal. of fire foam, or enough to extinguish a fire in a tank having 30 sq. ft. of exposed surface, are discharged directly to the tank, effectively putting out and keeping out the fire.

The device contains 6 gal. of each of the two Foamite solutions, and is suspended over the risk. When the device is operated by the first flash of heat, the solutions are combined in a mixing chamber, and within 10 seconds fire foam is being deposited on the fire. It is manufactured by Foamite-Childs Corporation.

FIG. 1 AUTOMATIC FIRE EXTINGUISHER

Steam Trap

TO meet severe service conditions caused by present-day use of high pressures and superheat, Armstrong Machine Works has designed a steam trap. It is made of annealed cast steel having a tensile strength of about 70,000 lb. Valves are heat-treated

FIG. 1 STEAM TRAP

chrome steel, and orifices are suitable for pressures up to 600 lb. Standard Armstrong Trap features, including top discharge, are embodied in the new item. Traps are hydraulically tested up to 3000 lb. to insure tightness of castings, joints, and valves.

Electrode Holder

A NEW type of welding electrode holder marketed by the General Electric Company allows welding operators to make a quick change from burnt stub to new electrode. The operator needs only to strike the stub end of the old electrode, causing it to drop out, when the new wire can be inserted instantly without unnecessary effort.

The new holder consists of a punched fiber tube with a tinned brass plug inserted in the end. A steel spring rod holds the electrode in place against one of a number of different sized notches provided for the purpose. The welding cable running to the source of power is soldered to the other end of the holder by removing the fiber tube and fiber guard, accomplished by loosening a single screw.

The construction of this holder is such that the contact of the electrode is not weakened by heat, since it does not depend upon any heat-affected spring.

Resistor Unit

A HEAVY-CURRENT resistor unit that is unbreakable, compact, and light in weight has been developed by Monitor Controller Company for all industrial installations where cast-iron grids or ribbon resistors are used. An alloy ribbon, of uniform composition, moisture-proof, acid-resisting, and of negligible temperature coefficient of resistivity is wound on edge in helical form. Each unit is mounted on a steel-reinforced porcelain support. The construction permits free radiation and connection of heat and relieves the units from mechanical strain so that they can be operated at any temperature up to red heat without sagging.

The only joints are at the terminals of the sections. Two forms of clamps provide facilities for connecting units in series or parallel, or for taking off taps at any desired points along the units.

Indicating Pyrometer

AN electric indicating pyrometer for wall or switchboard use, which has a 7-in. scale, making it easy to read from a distance, is being marketed by The Bristol Company.

Some of the construction and design features claimed for this device by the manufacturers are: high resistance movement, using a Weston millivoltmeter; permanent calibration; automatic cold-end compensation; dust-proof, cast-aluminum case; zero adjuster and index spotter; low chamber error; and high torque. This equipment can be furnished for all ranges

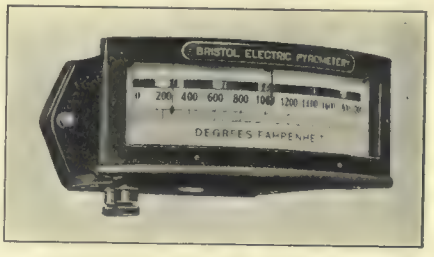


FIG. 1 INDICATING PYROMETER

up to 3000 deg. fahr. Scales within this limit can be supplied to suit individual needs.

Unit Pyrometer

INTERMITTENT, rough checking for control of manufacturing processes, of temperatures above the range of mercury thermometers (950 deg. fahr.) is the service for which the Tycos Thermopyre has been designed. It provides

a convenient means of obtaining relative checks of temperature in small quick-heating furnaces, muffles, checkers, stacks, kilns, back passes, flues, galvanizing kettles, melting pots, ovens, and other places where occasional checks at relative temperatures are desired.

It consists of a 39-in. calorized thermocouple, combined with a compact millivoltmeter having a scale range of 2200 deg. fahr. It is enclosed in an aluminum case and is equipped with a hardwood handle for convenience in handling, which has a ring for hanging. They are not precision instruments but are accurate within 20 deg. fahr., or one scale division, which is sufficiently accurate for many industrial applications. This device is made by Taylor Instrument Company.

Pipe Union

A UNION to connect pipes at any angle from a straight line to 90 deg., that can be put on in any direction, aligning itself by a rotary instead of a lateral motion, and that is leakproof, has just been put on the market by the Angle Union Corporation. The joint is formed by accurately ground beveled surfaces or contact planes, metal to metal, without washer. The nut merely holds the ends in place, line forces serving to lock it. These unions have been tested to 1200-lb. pressure without leaking.

One union of this type will replace many intricate combinations of ells, nipples, etc., as in the case of connections for gas, compressed air, oil, water, and other fluids. The unions are particularly adapted where a line must have pitch, for close quarters, and where connections must frequently be taken apart for cleaning. Assembly time is much reduced. Ample provision is made for wear.

The cross-sectional area of the Auco unions is greater than that of the corresponding pipe, and hence no contraction of flow occurs. As the nut fits at an angle, pipe lines may be run close to walls, giving free play to the wrench without injury to woodwork or plaster.

Unions are made in brass and malleable iron, black and galvanized, with female threads, or of the street-ell type, and in standard sizes from ½ to 2½ in.

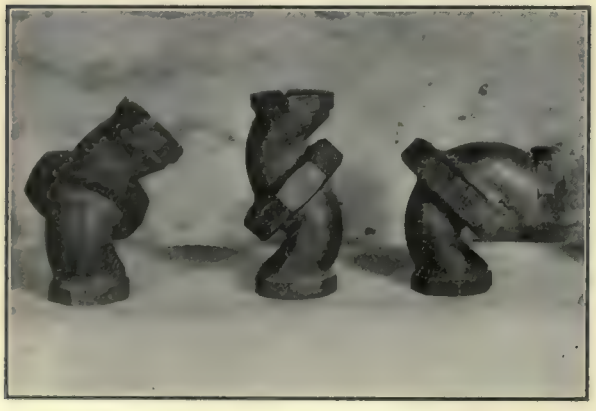


FIG. 1 LEAKPROOF PIPE UNIONS

CO_2 Indicator and Recorder

THE Ranarex gives a continuous CO_2 reading with short time lag; its scale is a foot wide, which can be easily read at a distance; it is dustproof and not affected by heat, moisture, or shock; it contains no chemicals, glass parts, small orifices, or delicate heating wires; its operation is simple; and the automatic recording device operates without clockwork, ink, or pens.

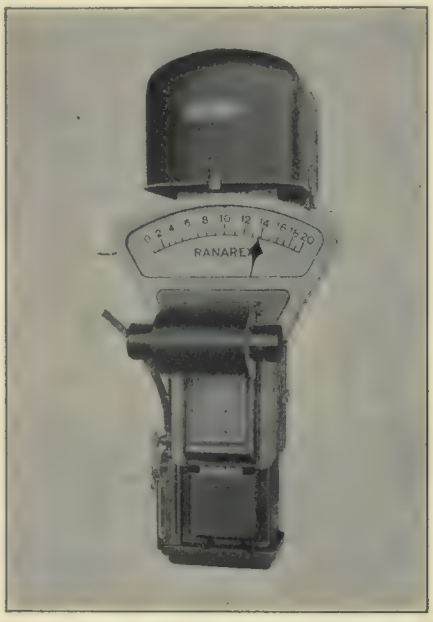


FIG. 1 CO_2 INDICATOR AND RECORDER

The device operates by comparing the specific weight of the flue gas with that of air. Scale indications are recorded by perforations in a strip of paper. The recording device is operated by a motor which also operates a duplex impeller by which gas is drawn into the chamber. The scale and paper record is illuminated by a lamp attached to a swinging bracket. This device is manufactured by The Permutit Company.

Portable Elevating Loader

A DEVICE for loading coal, sand and similar materials into trucks or cars and which can propel itself into the pile of material while the elevator is in operation has been placed on the market by George Haiss Manufacturing Company.

It consists of a flight elevator unit which is attached to a Fordson tractor in such a way that when moving the tractor it is not necessary to disconnect the elevator clutch. Because of this feature a pile of material covering a considerable area can be loaded without interruption of the loading operation and without the use of auxiliary equipment for bringing material to the intake end of the elevator.

A cast steel take-off box has been installed between the flywheel and the clutch of the tractor by taking out the bolts of the flywheel housing and attaching the rear end of the tractor to the box.

Ball Bearings

A NEW ball bearing has been placed on the market for which its manufacturers claim the following advantages: It has a grease retainer which will hold lubricant sufficient for an extended period of time. This retainer keeps the bearing free from dust and dirt and also permits the use of a simpler and less expensive mounting. The necessity of a separate seal is eliminated, and fewer parts, reduced machining operations and easier assembling are possible.

The lubricant retainer consists of a pressed-steel disk which is snapped into a grove in the outer race. The bearing contains a maximum number of larger-sized balls which are kept separate by a riveted "stay-rod" type ball cage. The curvatures of the groove are made to conform closely to that of the balls. Both the balls and the races are made of a high-carbon chrome alloy steel.

These bearings are being marketed by Standard Steel and Bearings, Inc.

Safety Switch

A QUICK-MAKE-AND-BREAK safety enclosed switch, which has been simply constructed to furnish greater reliability, less maintenance cost, and easier testing, inspecting, and repairing, has been developed by Westinghouse Electric and Manufacturing Company for use with industrial motors. It is called Type WK-60.

The quick operating mechanism is

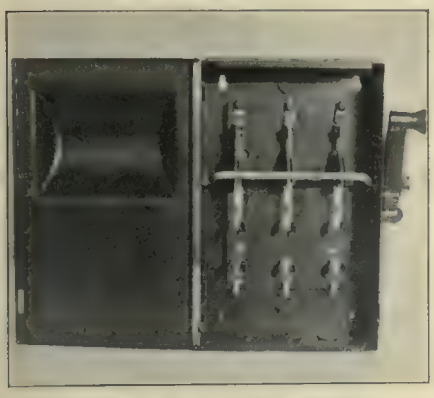


FIG. 1 SAFETY SWITCH

located inside the operating handle. Mechanical parts subject to wear have been hardened; parts exposed to corrosion have been galvanized, copper-plated, covered with baked enamel, or treated with wood-oil varnish; insulating materials have been made oil-, moisture-, and acid-proof; copper parts have been dipped and lacquered.

Rust-Resisting Pole

AN improvement has been made in the steel pole designed for use on telephone, power, lighting lines, and similar services, and described in the August 1924 issue of MANAGEMENT AND ADMINISTRATION. A small percentage of copper has been added to the steel from which it is constructed. After extensive tests, it has been proved that 0.15 per cent of copper in the steel mill will enable it to resist rust for an indefinitely long period. This copper-bearing steel pole is manufactured by Truscon Steel Company.

Electric Socket Wrench

FOR any work in which removing or tightening nuts, bolts, or studs is an important part, a new tool has been designed. A reversible electric socket wrench is being marketed by Black and Decker Manufacturing Company. It is similar in design and construction to their portable drills, with the exception of a clutch which automatically releases when forward pressure on the tool is relieved. This clutch is designed to drive nuts and bolts to any degree of tightness.

A reversing switch is provided for use in disassembling motors and machinery, and the manufacturers claim that their tool has enough power to loosen nuts or bolts regardless of how tight they are drawn up. The machine is equipped with a chuck into which different sizes of socket wrenches can be quickly fitted.

This company has also developed recently a motor-driven twist-drill grinder intended for use in small shops. It is designed for mounting either on a bench or on a pedestal.

The machine is equipped with one general-purpose grinding wheel. Twist

FIG. 1 REVERSIBLE ELECTRIC SOCKET WRENCH

drills are fed to the cup wheel by means of a micrometer screw feed. The design of the machine compensates for different sizes of drill so that any size up to capacity of the machine may be ground without adjustment. The grinder has a capacity for twist drills up to 5/8 in. diam., either straight or taper shank.

Standard equipment furnished with the grinder includes a tool rest, wheel guards, electric switch in the base, and a cable with plug for attachment to lamp sockets. A pedestal equipped with a water pot can be furnished if desired.

Equipment Catalogs

A 50-page booklet entitled "Detrick Arches" has been issued by M. H. Detrick Company. It describes and illustrates the design and construction of Detrick Arches and Furnace Walls, and contains a number of drawings showing their application to various types of furnaces.

Bulletin No. 106 issued by Monitor Controller Company describes the design and operation of their Thermaloid Motor Starter.

Bulletins Nos. 7 and 8 issued by Reading Steel Casting Company describe their extra-heavy cast-steel valves and 400-lb. W. S. P. cast-steel valves.

Parts List No. 9 is a price list of repair parts for sangamo Type H Watthour Meters, manufactured by Sangamo Electric Company.

Bulletin No. 45609 describes the general construction and principles of operation of the surface air cooler manufactured by the General Electric Company. It is illustrated by photographs and drawings. A partial list of installations of this make of cooler is included.

Bulletin No. 530 has been issued by Roller Smith Company to describe and give prices for their "Standard" Type Circuit Breakers and parts.

A 38-page booklet has been issued by General Electric Company, describing electric equipment for cranes. Information is given on operating characteristics, crane motors, control, brakes, etc., all illustrated with photographs, diagrams, tables and charts.

Description of their Vitrom (vitreous enameled) resistor units is given in Bulletin No. 63, recently published by Ward Leonard Electric Company.

Irving-Pitt Manufacturing Company has issued a booklet entitled "The First Twenty Years." It commemorates their twentieth anniversary and contains information about their plants, personnel, and products.

"Arc Welding and Cutting Manual" is a 127-page, cloth-bound book issued by General Electric Company to acquaint the uninformed in a general way with some of the applications of arc welding and with the manipulation and characteristics of the welding arc. Well illustrated with photographs, diagrams, and charts explaining the text.

Photographs of speed-reducer applications and a variety of tables for the determination of necessary factors in selecting a speed reducer are given in a 79-page book issued by Foote Brothers Gear and Machine Company. Prices of their equipment are quoted.

Foamite-Childs Corporation has issued a bulletin called "Correct Protection Against Fire," in which fire prevention methods are described and compared.

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 100 magazines; it also includes the publications of some 50 book publishers and professional societies as far as these are of managerial interest to industrial executives. The decimal number at the right of each item is the index number and indicates the place the article or book will take when filed in accordance therewith in the classified subject scheme. If articles are grouped according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. Photostat copies of any magazine article indexed will be supplied by The Ronald Press Company within a year following the date of publication at a price of 25 cents the page. When ordering photostats please identify the article by quoting from the index: (1) Title of article; (2) Index number; (3) Name, date, volume number, and page number of periodical in which the item appears. A remittance of 25 cents a page should accompany the order. The books and pamphlets indexed can be procured from The Ronald Press Company or from their respective publishers.

Industrial Buildings and Plant Maintenance

Buildings and Equipment

Illumination of Railroad Shops and Roundhouses. 658.242
Railway Review, December 6, 1924, v. 75, pp. 915-919. Illus. Extracts from report of committee of the Association of Railway Electrical Engineers, recommending standard practice to meet requirements of safety and efficiency.

Industrial Lighting with Electricity. 658.24
J. W. Beauchamp. *Business Organization and Management*, December 1924, v. 11, pp. 177-180. Good artificial lighting always pays for itself in better work, increased production, greater freedom from accidents, and improved health of the workers. High-power lamps, operated efficiently and equipped with suitable reflectors should be used.

New Automobile Exhibition Building. 658.2
J. Krämer and H. Schmuckler. *Zeitschrift des Vereines Deutscher Ingenieure*, December 13, 1924, v. 68, pp. 1298-1301. Description of the structure just completed for the national association of the automobile industry.

Planning the New Building. 658.2
A. G. Anderson. MANAGEMENT AND ADMINISTRATION, February 1925, v. 9, pp. 117-120. Detail analysis made by a manufacturing company to determine size, layout, and all related factors, in planning for the erection of a new plant.

Steel Sash—More Light. 658.23
R. S. Bishop. MANAGEMENT AND ADMINISTRATION, January 1925, v. 9, pp. 27-28. Steel window sash provides more light, better ventilation, fire protection, and decreased maintenance.

Maintenance and Repairs

Maintenance and Operating Costs. 657.452
J. L. McK. Yardley. *Industrial Engineer*, December 1924, v. 82, pp. 566-570, 601. Illus. Relations between the two costs in the manufacture of prepared roofing, together with details of production and the equipment required.

Paint Protection in the Modern Power Plant. 658.58
Roy C. Sheeler. *Steam Power*, December 1924, v. 3, pp. 5, 14. Statement of specific problems and their solution.

Plant Maintenance (IV. Belts, Shafting, and Hangers). 658.583
K. D. Hamilton. *Factory*, December 1924, v. 33, pp. 790, 794. Illus. Savings from the proper maintenance and up-keep of power-transmission machinery and the organization and management of a factory maintenance department.

Reclaiming Scrapped Grinding Wheels. 658.5671
F. W. Brown. *Iron Trade Review*, December 4, 1924, v. 45, pp. 1499-1500. Illus. Methods producing large savings at the Continental Motors Corporation plant.

Standardization of Textile Mill Lubrication. 677:621.89
Allen F. Brewer. *Textile World*, December 6, 1924, v. 66, pp. 87, 89. Importance of standard specifications for lubricants. These should include viscosity, specific gravity, flash point, firepoint, pour test, and nature and extent of fixed oil compounds.

Standardization of Textile Mill Lubrication. 677:621.89
Allen F. Brewer. *Textile World*, January 3, 1925, v. 67, pp. 69-71. Care and storage of lubricants; location and construction of oil houses, storage tanks and accessories; shipping containers; issue and delivery of lubricants.

Industrial Methods

Applications of the Oxy-Acetylene Process. 665.882
E. L. Swangren. *Acetylene Journal*, January 1925, v. 26, pp. 325-328. Uses of welding and cutting equipment in Hawthorne plant of Western Electric Company.

Electric Furnaces for Medium Temperatures. Part 2. 669.8
C. F. Cone. *Forging—Stamping—Heat Treating*, December 1924, v. 10, pp. 467-471. Typical installations which have facilitated production, economized space, simplified material handling and lowered costs.

Welding Methods in German Shops. 671
Introducing autogenous welding. Welding methods in the blacksmith shop. Welding of castings. Observations on electric arc welding. New developments in the realm of electric welding. Developments in electric spot welding. Autogenous aluminum welding. Copper welding in locomotive construction. *Werkstattstechnik*, November 15, 1924, v. 18, pp. 633-660. Illus. A series of articles describing the above processes, and giving examples of their applications.

Power Generation and Transmission

Fuel

Burning Factory Wastes. 658.5671
(Turning a nuisance to profit.) Einar Winholt. *Factory*, December 1924, v. 33, p. 788. Illus. Methods used by Deere and Company to generate steam from waste wood, excelsior, cardboard, paper and the like.

Burning Natural Gas. 621.1824
J. O. Thoen. *Combustion*, December 1924, v. 11, pp. 440-441. Comparative utility of natural gas as a fuel for boiler operation.

The Fuel Oil Resources of the Future. 662.6
A. W. Nash and H. G. Shatwell. *Colliery Guardian*, December 5, 1924, v. 128, pp. 1435-1436. Possibility of extracting oil from coal and then using the coal for domestic purposes.

Heating in the Coal Pile. 662.6
J. F. Springer. *Combustion*, January 1925, v. 12, pp. 34-38. Suggestions for determining degree of heating and methods for preventing excess.

Power Plant Operation

Attacking Power Losses in Transmission and Utilization. 658.583
T. Croft. *Industrial Management*, December 1924, v. 68, pp. 349-356. Illus. How to find the sources of waste and eliminate them.

Combustion in the Power Plant. 662.65
Thomas A. March. Combustion Publishing Corporation, New York, 255 pp. $2. The first 86 pages give sources of coal, with characteristics of kinds from each source, together with information relative to proper selection and purchase. There follow data on selection and use of stokers, furnaces, and boilers; analysis of draft problems; information concerning power plant operation, with methods of investigating trouble; and ash disposal. A very practical book, sure to be valuable to everyone connected with power plants.

Designing a 500-Horsepower Steam Power Plant. 658.261
Charles L. Hubbard. *Southern Engineer*, December 1924, v. 42, pp. 35-39. Economic advantages of extraction type steam turbines, using heating system as a condenser, and condenser equipment, and determination of size and number of prime movers.

Efficient Power Plant Operation. 658.621
H. Brunner. MANAGEMENT AND ADMINISTRATION, February 1925, v. 9, pp. 125-128. Hand fired, 1000-hp. steam power plant attains operating efficiency of over 70 per cent. How it was done.

Electricity in Cotton Factories. 658.262:677
World Power, December 1924, v. 2, pp. 362-364. Illus. Various applications to spinning and winding machinery, and their advantages with examples from a Brazil mill.

Electric Power Applications in Pacific Northwest Fir Mills. 621.34
J. L. Wright. *Journal of the American Institute of Electrical Engineers*, December 1924, v. 43, pp. 1117-1123. Advantages as applied to various operations; results of tests; table of types of motors and controls, horsepower and methods of drive as to all kinds of mill service.

Firing a Hand-Fired Down Draft Furnace. 669.8
J. F. Barkley. *Steam Power*, December 1924, v. 3, pp. 7, 10, 12. Results of comparative tests for determining best equipment and operating methods.

Generating Power at Lower Cost. 658.261
P. C. Eppelsheimer. MANAGEMENT AND ADMINISTRATION, January 1925, v. 9, pp. 11-14. Operating economies obtained at South Philadelphia works of Westinghouse. Methods used.

Interconnection of Power Systems in the Southeastern States. 621.31003
W. E. Mitchell. *Journal of the American Institute of Electrical Engineers*, December 1924, v. 43, pp. 1150-1153. History of development; management and general operating features involved in interconnections.

The Magnitude and Prevention of Air Infiltration Losses in Power Plants. 621.101
C. H. S. Tupholme. *World Power*, December 1924, v. 2, pp. 348-351. Ratios of utilized heat, and various avoidable and unavoidable losses, causes of losses, and methods of prevention.

Operating Results at Large Power Plant. 658.261
E. H. Tenney. *Steam Coal Buyer*, December 1924, v. 2, pp. 11-13. Factors influencing location and design. Handling, preparation, and combustion of pulverized coal.

Organizing to Reduce the Cost of Power. 658.261
J. P. Jordan. *Industrial Management*, December 1924, v. 68, pp. 336-340. A defining and outlining of the factors involved in power production, such as electricity, steam, etc.

Scientific Control of Steam Generation in Factories. 658.261
H. S. Rowe. *Mechanical World*, November 28, 1924, v. 76, pp. 348-349. Emphasizes the importance of managerial attention being directed to power-plant operation in order to assure capable supervision, use of efficient equipment and personnel, and profitable operating procedure.

Which—Super Power or Super Heat? 658.621
Egbert Douglas. *American Industries*, December 1924, v. 25, pp. 5-8. Steam for heating purposes is so necessary for a large part of the year that its production is a greater problem than whether power shall be produced by steam or water power.

Power Equipment

Chain Power Transmission as a Feature of Efficient Building Design. 658.262
L. W. Spillan. *Buildings*, December 1924, v. 62, pp. 1387-1389. Applications to equipment improve operation.

Combustion Devices for Gaseous Fuels. 662.76
W. Trinks. *Fuels and Furnaces*, December 1924, v. 2, pp. 1249-1252. Factors governing selection of burners for various operating conditions.

A Compendium of Modern Power Plant Equipment. 658.261
J. T. Beard, 2nd. *Industrial Management*, December 1924, v. 68, pp. 331-335. Defining power apparatus and appliances and showing their relation to the cost sheet.

Compressorless Diesel Engines. 621.4342
Engineering Progress, December 1924, v. 5, pp. 249-253. Non-technical description of present types of industrial Diesel engines used in Germany for economy of operation.

The Diesel Engine Power Plant. 621.4342
Louis R. Ford. *Southern Engineer*, December 1924, v. 42, pp. 55-58. Economic advantages, operating characteristics and adaptability of Diesel engines.

Electrically Operated Coal Pier. 662.6
R. W. McNeill. *Southern Engineer*, December 1924, v. 42, pp. 40-44. Factors influencing choice, and design and operation of Western Maryland Railways Company's coal pier at Port Covington, Baltimore.

The Steam Accumulator. 621.18
Friedrich Münzinger. *Combustion*, December 1924, v. 11, pp. 430-435. Economic advantages of the Ruths steam accumulator in overcoming the disadvantages of fluctuating steam load. Capital outlay, fuel consumption, and production are affected advantageously by its use.

Marketing and Distribution

Advertising

Apportioning the Industrial Advertising Budget. 659.13
Harry M. Hitchcock. *Advertising and Selling Fortnightly*, December 17, 1924, v. 4, p. 38. An article suggesting that the appropriation should be fitted to the requirements, not the requirements to the appropriation.

Are Your Returns from Advertising What They Should Be? 659.1
B. L. Shinn. *Automotive Industries*, December 4, 1924, v. 51, pp. 976-978. Overstatement of fact, careless language in advertising a guarantee, "knocking" a competitor's product are a few "dont's" for advertisers.

Dry-as-Dust Charts vs. the Other Kinds. 659.13
Don Gridley. *Printers' Ink*, December 11, 1924, v. 129, pp. 53, 54, 56. Suggestions as to the use of charts in advertising.

Export Advertising Practice. 659.13
Dirk P. De Young. MANAGEMENT AND ADMINISTRATION, January 1925, v. 9, pp. 29-32. Expert advice and assistance based on knowledge of foreign psychology greatly increase returns from foreign advertising.

Getting a Fresh Viewpoint on Advertising Problems. 659.13
Harold Herd. *Business Organization and Management*, December 1924, v. 11, pp. 183-187. Importance of making a detailed analysis of each problem in order to bring each influencing factor to the front and to stimulate mental processes. Suggests that lines of investigations on various subjects be charted to facilitate future analysis.

Getting Productive Distribution for Industrial Catalogues. 659.132
A. L. Townsend. *Printers' Ink*, December 18, 1924, v. 129, pp. 129-131.

How Shall We Say It? 659.13
Amos Bradbury. *Printers' Ink*, December 18, 1924, v. 129, pp. 70, 72, 77, 78, 80, 84. A discussion of advertising copy from the standpoint of style.

Just How Informal Can Industrial Copy Be? 659.131
R. T. O'Connell. *Printers' Ink Monthly*, January 1925, v. 10, pp. 52, 53. Advocates a certain degree of "friendliness" in industrial advertising as "informal copy—of the right kind—often has a real sale pull."

Making a Slow Moving Staple Hustle. 658.82
Dana Hubbard. *Printers' Ink*, December 11, 1924, v. 129, pp. 156, 159, 160, 162. Suggests increase of sales by advertising new or other uses of a product.

Public Relations. 659.1
John C. Long. McGraw Hill Book Company, New York. 248 pp. $3. A handbook showing the place, purpose, possibilities, and methods of obtaining publicity. In the first part of the book is described the media of publicity with the possibilities and best methods of using them. Then effective publicity for various sorts of business enterprises is discussed.

Why Don't Manufacturers List Prices in Industrial Advertising? 659.13
Russell T. Gray. *Advertising and Selling Fortnightly*, December 31, 1924, v. 4, pp. 15, 16, 43. A policy article suggesting the advisability of bringing prices into industrial advertising.

Selling

Control in Industrial Gas Business. 669.8
A. J. Smith. *American Gas Journal*, December 27, 1924, v. 121, pp. 1307-1308, 1327. Co-operation between manufacturers of gas furnaces, etc., and local gas companies to furnish best type of apparatus to industries.

Cost and Selling Price Graphs. 657.452:311
W. E. Haseltine. *Textile World*, December 20, 1924, v. 66, pp. 51, 53. Construction of graphic chart for quick determination of costs and selling prices for knitted products.

Demonstrations and Sales Bulletins That Get Dealer Co-operation. 659.13
Harold Whitehead. *Printers' Ink Monthly*, December 1924, v. 9, pp. 50, 52. Suggestions and plans for interesting the dealer in a manufacturer's output.

Halt Automotive Credit Abuses. 322.7:629.1
D. Cassidy. *Michigan Manufacturer and Financial Record*, December 20, 1924, v. 34, pp. 5, 26. New association formed to stabilize business by regulating time payments.

How to Tell Whether a New Salesman Will Fail or Succeed. 658.801
Roland Cole. *Printers' Ink Monthly*, January 1925, v. 10, pp. 31, 32, 84, 87. Methods used by the Phoenix Mutual Life Insurance Company in selecting salesmen.

Ideas That Help Me Sell Your Merchandise More Intelligently. 659.13
A. H. von Voris. *Printers' Ink Monthly*, December 1924, v. 9, pp. 80, 83, 84, 89. Suggestions and plans, for helping the dealer sell the manufacturer's output.

Measuring Sales Effort Results. 658.808
W. A. McDermid. MANAGEMENT AND ADMINISTRATION, January 1925, v. 9, pp. 33-37. Importance and methods of determining accurately costs of distribution.

"Our Records Tell Us—" 658.817
I. R. Jacobs. *System*, January 1925, v. 47, pp. 51-53. A description of records that show daily "the total volume and gross profits by salesmen and the merchandise on hand by items."

Paving the Way for the Salesman. 659.13
G. A. Nichols. *Printers' Ink*, December 1924, v. 129, pp. 126, 129, 130, 132, 134-136, 138, 140, 142. Advance advertising to the dealer to prepare the way for the salesman.

Selecting the Best Name for Your Product. 659.13
Richard B. Franken. *Printers' Ink Monthly*, December 1924, v. 9, pp. 45, 46, 132, 135, 136. A practical discussion of the principles that should govern the selection of a product name.

Shall We Use Vocational Selling? 658.82
(Editorial). *System*, January 1925, v. 47, pp. 40-43, 89. A discussion of the advantages and disadvantages of specialized sales efforts.

Taking Your Personal Inventory. 658.85
M. G. Weaver. *American Gas Journal*, December 27, 1924, v. 121, pp. 1309, 1326. An analysis of a salesman's errors.

To Reduce the Cost of Selling. 658.808
Ralph Barstow. *Business*, January 1925, v. 6, pp. 22, 23, 30, 32. A broad consideration of the influences that affect selling costs.

What Are You—A *Sales Manager* or a Sales-*Manager?* 658.811
Marsh K. Powers. *Sales Management*, December 1924, v. 7, pp. 1833, 1924, 1926, 1927. An article emphasizing the fact that executive ability is of more importance than selling ability for the sales-manager.

What a Sales-Manager Owes His Men. 658.811
Carl E. Sommer. *Sales Management*, December 1924, v. 7, pp. 1841, 1842. Points out the sales-manager's duty to co-operate with his salesmen and their customers, especially in the matter of collections.

What Do Your Salesmen Sell? 658.85
G. A. Nichols. *Printers' Ink Monthly*, December 1924, v. 9, pp. 27, 28, 112-118. The right appeal to sell quality goods in the face of lower-price competition.

When Your Salesmen Grow Stale. 658.807
Charles C. Casey. MANAGEMENT AND ADMINISTRATION, February 1925, v. 9, pp. 157-158. Methods of keeping salesmen interested in their work.

Why Some Salesmen Do Not Make Good. 658.85
Victor Woodward. *Advertising and Selling Fortnightly*, December 3, 1924, v. 4, pp. 54, 56, 57. Shows that salesmen's failures are frequently the fault of the management.

Why You Can't Do Too Much for Customers. 658.91
Julius Rosenwald. *System*, December 1924, v. 46, pp. 709, 712, 777, 779. Direct mail merchandizers overcome place utility advantages of local merchants by giving more attention to consumer needs and wants and establishing a reputation for efficiency of service and reliability of product.

Shipping

Consumer Packages in Foreign Trade. 658.78844
Dirk P. De Young. MANAGEMENT AND ADMINISTRATION, February 1925, v. 9, pp. 139-142. Importance of proper packaging in connection with transportation costs, deterioration of product, and advertising effect on consumers.

Cutting Down Shipping Losses. 658.788444
H. H. Squire. MANAGEMENT AND ADMINISTRATION, January 1925, v. 9, pp. 47-50. Proper selection of containers an important factor in safe and low cost delivery of manufactured products.

Making Freight Shipments Pay Profits. 656.23
Robert T. Kent. MANAGEMENT AND ADMINISTRATION, February 1925, v. 9, pp. 159-162. Savings possible from thorough study of problem of packing and routing shipments considered in connection with freight rates and schedules.

Observations of a Superintendent of Motor-Truck Fleet-Operation. 656.124
J. F. Winchester. *Journal of the Society of Automotive Engineers*, December 1924, v. 15, pp. 567-579. Discussion of inspection, performance records, repairs, operative features, etc., as presented in a previous article under the same title in the May 1924 Society of Automotive Engineers Journal.

The Package Problem as a Factor in Sales and Profits. 658.7884
C. W. Hamilton. *Sales Management*, December 1924, v. 7, pp. 1901, 1902. An article showing how directly sales and consequent profits are affected by the size and style of package employed.

Preparing and Loading Automobiles for Shipment. 658.7884
B. R. Moore. *Journal of the Society of Automotive Engineers*, December 1924, v. 15, pp. 511-515. Illus. Methods and devices utilized for railroad shipment, to reduce costs, insure safety, and economize space.

Principles of Importing. 382
Wayne E. Butterbaugh. D. Appleton and Company, New York. 473 pp., $5. A comprehensive study of the whole field of importing—a heretofore neglected part of foreign trade literature. The author de-

scribes the organization of an import house. Then he describes in detail each of the transactions involved in importing. These include the purchase of goods abroad, the inspection, packing, marking, and shipping from the foreign country, the procedure used in passing the purchases through the customs, and, finally, their distribution and consumption. Considerable emphasis has been placed on customs procedure and upon the numerous forms used. The book should be valuable to all business concerns that make purchases overseas.

Protecting Foreign Shipments. 368.8
H. L. Gibson. MANAGEMENT AND ADMINISTRATION, January 1925, v. 9, pp. 39-40. Insurance against credit risks.

When Does a Motor Truck Become Obsolete? 656.124
F. W. Davis. *Journal of the Society of Automotive Engineers,* December 1924, v. 15, pp. 516-520. Depreciation, obsolescence, maintenance and other factors entering into the decision whether to buy new trucks or repair the old.

Administration and Policy

Administration and Policy

The Drop Forging Industry as the Buyer Sees It. 621.73
C. E. Bement. *Forging—Stamping—Heat Treating,* December 1924, v. 10, pp. 452-454. Lack of research and investigation on important phases of practice retards normal development.

Forecasting Your Industry's Cycle, IV. 338.97
Joseph H. Barber. MANAGEMENT AND ADMINISTRATION, January 1925, v. 9, pp. 15-20. Method of determining relation between specific external cycle curves with that of an industry's specific cycle to provide a basis for forecasting quantitatively the industry's cycle.

Is Forecasting Worth While? 338.97
Joseph H. Barber. MANAGEMENT AND ADMINISTRATION, February 1925, v. 9, pp. 129-133. What forecasting should accomplish, together with an account of what it has accomplished in the Walworth Manufacturing Company.

The Machine Tool Requirements of Japan. 621.9
S. Noda. *Machinery,* January 1925, v. 31, p. 350. Statistics of Japanese industry; competition; opportunities for American machine tools.

Measuring Mass Buying Habits by Probing the Individual. 658.808
Harry Tipper. *Advertising and Selling Fortnightly,* December 17, 1924, v. 4, pp. 26, 52, 53. Suggests "a thorough study and analysis of a few human beings rather than theorizing about the psychology of the masses."

A Platform of Business Principles. 174
Calvin Coolidge. *The Nation's Business,* December 1924, v. 12, pp. 35-37. The President's ideas of the relations of the Federal government to business with his proposals for working out those relations.

A Policy That Guided 118 Years of Steady Growth. 658.01
Sidney M. Colgate. *System,* December 1924, v. 46, pp. 717-720, 783-785. "Conserve and progress" has been the principle underlying Colgate and Company's policy.

What Are the Yardsticks of Business? 338.97
W. L. Glenzing. *Printers' Ink Monthly,* January 1925, v. 10, pp. 30, 120. A discussion of the real measures of business conditions and business progress.

Economics

Can Business Depressions Be Prevented? 338.97
J. L. Stixrud. *Commerce Journal,* December 1924, v. 5, pp. 4-8. "Yes," believes the author, at least their effect can be greatly reduced. Individual study of conditions, decisions based on personal deduction rather than on opinions of others, and definite action following sound conviction are offered as means of offsetting effects of depressions.

Codes of Ethics. 174.4
Edgar L. Heermance. Free Press Printing Company, Burlington, Vt. 525 pp. $4. A collection of ethical codes adopted by over 200 business organizations throughout the country. It provides a source of information for organizations preparing to draft or revise standards, and also presents concrete evidence of the ethical movement that has progressed so rapidly during recent years.

Elements of Statistics. 311
Frederick C. Kent. McGraw Hill Book Company, New York. 178 pp. $2. A textbook for an introductory course in the study of statistical methods. Sources, collection and tabulation of statistical data discussed briefly, followed by the proper use of graphics. The remaining chapters, covering measures of central tendencies, index numbers, measures of dispersion, normal frequency curves, and correlation are, necessarily, technical and will be intelligible only to those who have a considerable knowledge of mathematics. To persons with such a foundation the book will provide a short and concise text on the most frequently used statistical methods.

Fears Split-Up of Industry. 656.23
Michigan Manufacturer and Financial Record, December 6, 1924, v. 34, pp. 10, 30. Proposed freight rate changes and their probable effect on western industries.

Foreign Trade Prospects. 382
Machinery, January 1925, v. 31, pp. 374-378. Markets, competition and the economic situation in Great Britain, France, Belgium, Italy, Germany, the rest of Europe, Australia and New Zealand.

The German Coal Syndicate and the Ironworks. 671
Iron and Coal Trades Review, December 5, 1924, v. 109, p. 928. The control of coal by the ironworks group and the advantages it gives them over competitors.

Material Handling and Production Control

Material Control

How Warehousing Can Prevent Seasonal Manufacturing. 658.784
H. A. Haring. *Printers' Ink,* December 4, 1924, v. 129, pp. 107, 108, 113-116. Suggestions for increasing sales and reducing costs through warehousing.

How Warehousing Can Promote "Spot" Stock Turnover. 658.784
H. A. Haring. *Printers' Ink,* November 20, 1924, v. 129, pp. 57, 58, 60, 64, 69, 70. A discussion of the function and importance of local warehousing in holding customers and promoting sales.

How Warehousing Can Protect and Finance Merchandise. 658.784
H. A. Haring. *Printers' Ink,* December 18, 1924, v. 129, pp. 155, 156, 158, 161-164, 166 (third article). Increasing sales and reducing costs by means of local warehouses.

Shelves and Racks in Industrial Storerooms. 658.235
F. E. Gooding. *Industrial Engineer,* December 1924, v. 82, pp. 571-573, 602-603. Illus. Equipment for storing miscellaneous repair and maintenance parts and supplies, and material before, after, and during manufacture.

Soo Line Has Unique Stores Organization. 658.78
Railway Review, December 13, 1924, v. 75, pp. 943-949. Illus. Description of the main store of the Soo Line at Minneapolis. Organization, delivery system, care and control of material, reclamation, scrap disposal, etc.

Mechanical Handling

Experience of Forty Pump Users. 621.86
E. S. Hanson. *Cement, Mill and Quarry,* December 5, 1924, v. 25, pp. 7-10. Illus. Handling raw material in the sand and gravel industry by pumps. Data on per cent of solids, kind of motive power, length of pipe lines, life of equipment, and a few costs.

Gravity Bucket and Tray Conveyors for Coal and Coke Handling. 658.2812
A. Lennox. *The Gas Engineer,* December 1924, v. 40, pp. 271. Advantages and limitations.

How Mechanical Handling Cuts Power Costs. 658.281
M. W. Potts. *Industrial Management,* December 1924, v. 68, pp. 341-348. Illus.

Diagrams and descriptions of various methods of handling coal and ashes.

Industrial and Commercial Applications of the Tractor. 658.281
G. D. Babcock. *Journal of the Society of Automotive Engineers*, December 1924, v. 15, pp. 536-538. A discussion of the previous article under this title appearing in the September 1924 Society of Automotive Engineers Journal.

Savings in Material Handling. 658.281
George E. Hagemann. MANAGEMENT AND ADMINISTRATION, January 1925, v. 9, pp. 51-54. Experience data with comparative costs on several installations of mechanical handling equipment.

Simpler Methods of Moving Materials. 658.281
Chester Lynndelle. *Factory*, December 1924, v. 33, pp. 798-800.

Production Control

Close Checking of Short Swing Trends Cuts Selling Costs. 658.513
Automotive Industries, December 4, 1924, v. 51, pp. 957-959. Production schedules of Olds motor works are based on forecasts which are executive decisions resulting from a study of field men and distributor's reports, statistical data on car stocks, and previous sales records.

Effecting Economies by Regulating Work Flow. 658.5
A. Whitehead. *Cassier's Industrial Management*, December 1924, v. 11, pp. 497-498. Method of keeping a record of output.

Effective Manufacturing Control. 658.5
(Control That Makes Possible Our 30-Day Turn.) R. J. Reiser. *Factory*, December 1924, v. 33, pp. 786-787. Improvements in systematization in a wood-working plant which increased production 50 per cent, reduced working force 25 per cent, lessened supervision 30 per cent.

Inspection Methods. 658.562
(Keeping Track of Quality.) A. H. Frauenthal. *American Machinist*, January 1, 1925, v. 62, pp. 7-11. Takes up inspection methods from the results point of view. Inspection department should protect against inferior material, incorrect parts, and loss of material due to incorrect fabrication.

Inspection Methods. 658.562
Earle Buckingham. *Mechanical Engineering*, January 1925, v. 47, pp. 55-56. Inspection is presented as a preventative practice in manufacturing. The two logical divisions are: process inspection, and final inspection.

Inspection Standards for Steel Castings. 658.516:671
W. J. Forbett. *Iron Age*, January 8, 1925, v. 115, pp. 115-119. Illus. Standards developed by a group of electrical steel foundries based on extensive research and intended to meet specialization in purchase requirements.

An Interesting Wheel and Axle Shop. 658.5:625.2
Railway Review, December 20, 1924, v. 75, pp. 977-987. Illus. Equipment and methods used for handling wheels and axles to improve production at the Newport News Shipbuilding and Dry Dock Co. shops.

Production. 658.5
D. Bennett. *World Power*, December 1924, v. 2, pp. 319-322. Illus. Establishing and adhering to schedules of work; weekly production meetings; typical control charts.

Production Control. 658.5
(How We Maintain a Smooth Flow of Production.) E. F. Roberts. *Factory*, December 1924, v. 33, pp. 794-797. Illus. Description of the use of a schedule control board in the plant of the Packard Motor Car Company. Control covers raw and semi-finished materials, processes and manufacturing conditions.

Production Control. 658.5
G. D. Babcock. *American Machinist*, December 18, 1924, v. 61, pp. 963-970. An outline of production control in manufacturing taking up output with given equipment, planning, manufacturing programs, determination of lot sizes, production schedules, operation analysis, stores systems, dispatching, inspection, maintenance.

Reducing the Cost of Locomotive Repairs. 658.5:625.2
W. S. Cozad. *Railway Mechanical Engineer*, December 1924, v. 98, pp. 750-757. Illus. Results of production methods applied in the Lehigh Valley Shops at Packerton, Pa., with time data.

Straight Line Passenger Car Repair Shops. 658.5:625.2
L. Richardson. *Railway Review*, December 13, 1924, v. 75, pp. 949-952. Illus. Application of industrial production principles to facilitate work and lower costs.

Employment and Management

Management

Business Administration. 658
James O. McKinsey. South-Western Publishing Company, Cincinnati. 318 pp. $1.40. Designed to give a general picture of business operations, with particular emphasis being placed on the "why" rather than on the "how." The subject matter is divided into six main parts which treat with organization, and with the administration of marketing problems, production, personnel, finance, and standards and records. It has been written as a textbook, with questions and problems after each chapter, but it provides a source of information about the general principles of business administration which will be useful to many business men.

Charts as Management Tools. 658.53
Arthur R. Burnett. MANAGEMENNT AND ADMINISTRATION, January 1925, v. 9, pp. 55-58. Design and operation of graphs for showing important information quickly, accurately, and simply.

Committees as Aids to Management. 658.31514
A. G. Peter. *Industrial Management*, December 1924, v. 68, pp. 362-365. Advantages and disadvantages of this form of executive control.

Common Sense in Business. 651.4
H. G. Stoddard. *Forging—Stamping—Heat Treating*, December 1924, v. 10, pp. 457-458. Knowledge through specific and unceasing study of the facts and forces affecting a business enterprise essential to success and efficient service.

Co-Ordinating Plant Layout with Production. 658.232
C. G. Stoll. *The Society of Industrial Engineers Bulletin*, December 1924, v. 6, pp. 3-7. Brief description of the method of organizing and co-ordinating the operation of the manufacturing departments of the Western Electric Company. The seven branches included are: production, technical, operating, industrial relations, inspection, clerical, development.

Efficiency in a Cotton Piece Goods Dyehouse. 658.667
Winn W. Chase. *Textile World*, December 27, 1924, v. 66, pp. 37, 39, 41, 43. Influence of location, layout, equipment, organization, records, and accounting methods on operating efficiency.

How We Sold Simplification to Our Retailers. 658.82
Fletcher H. Montgomery. *System*, January 1925, v. 47, pp. 29-33, 112-116. Discusses the practical effect of standardization in the output of the Knox Hat Company.

Job Study May Increase Production by 80 Per Cent. 658.511
Henry H. Farquhar. *Automotive Industries*, December 4, 1924, v. 51, pp. 970-972.

Mistakes That Executives Make. 658.16
C. E. Knoeppel. *Industrial Management*, December 1924, v. 68, pp. 377-382. Typical cases of how enterprises have been wrecked by men who failed to build up self-reliant organizations on sound management principles.

My Test of Management-Handling Exceptions. 658.31242
Charles Piez. *System*, January 1925, v. 47, pp. 37, 38. A protest against overwork on the part of the executive with suggestions as to how it may be avoided.

A New Graphical Solution. 658.542
Carl G. Barth. MANAGEMENT AND ADMINISTRATION, February 1925, v. 9, pp. 143-144. For time allowances in rate and task setting.

Profit-Making Factory Management. 658.2
B. A. Franklin. MANAGEMENT AND ADMINISTRATION, February 1925, v. 9, pp. 149-152. Necessity for preventing poor condition or obsolescence of mechanical equip-

ment lowering its output beyond the quantity or quality obtained from hand labor it displaced.

Profit-Making Management in the Factory. 658
B. A. Franklin. MANAGEMENT AND ADMINISTRATION, January 1925, v. 9, pp. 21-26. Availability of modern management engineering methods for managing a factory so that a good product can be sold at a fair price, stockholders receive adequate dividends, employees' wages and working conditions are satisfactory to them, and the plant properly maintained.

The Road Maps of Industry. 658.53
Leonard P. Ayres. MANAGEMENT AND ADMINISTRATION, January 1925, v. 9, pp. 9-10. Value of charts and diagrams to industrial executives.

Standards in Clothing Manufacture. 658.516:687
George E. F. Saum. MANAGEMENT AND ADMINISTRATION, January 1925, v. 9, pp. 59-61. Progress of size standardization in garment industry.

The Trend in Modern Machine Tool Design. 621.9
Machinery, January 1925, v. 31, pp. 339-345. A summary of recent developments, as an aid to the manager in selecting machine tool equipment.

Twenty Years of Modern Management. 658
Dexter S. Kimball. MANAGEMENT AND ADMINISTRATION, February 1925, v. 9, pp. 113-116. Review of progress in collection of scientific classified knowledge in the field of business management.

Waste Elimination Through Executive Control. 658.56
W. Penn Lukens. MANAGEMENT AND ADMINISTRATION, January 1925, v. 9, pp. 63-66. A carefully arranged and consistent program of waste elimination will have favorable influence upon the balance sheet.

Personnel

An Apprentice Tells His Thoughts. 658.3862
Iron Trade Review, December 18, 1924, v. 45, pp. 1641-1643. Experiences in a foundry training course.

The Case for Profit Sharing. 658.324
Cassier's Industrial Management, December 1924, v. 11, pp. 499-501. Proposed form of profit sharing which is expected to increase output, reduce costs, and curtail waste.

Company Welfare Work. 658.383
Frank Smith. *The Gas Industry*, December 1924, v. 24, pp. 451-454. Restaurant service and equipment of Prudential Insurance Company of America.

Employees' Health and Welfare. 658.3822
(Take Care of the Workman). H. S. Riggs. *American Machinist*, January 1, 1925, v. 62, pp. 17-19. Illus. The health, safety, and sanitation precautions adopted by the Lodge and Shipley Machine Tool Company.

Employee Stockholders. 658.3174
(Why 70 Per Cent of Our 425 Employees Are Stockholders.) J. E. Dann. *Factory*, December 1924, v. 33, pp. 800-802. Illus. Methods used to secure co-operation in a working force of young women from 16 to 25 years of age.

Employment Records. 658.3123
C. B. Bartlett. The Ronald Press Company, New York. 71 pp. $1.25. A collection of forms for use in large industrial enterprises for control of employee hiring, recording their progress in and service to the organization, and assembly of employment data for determining turnover and other labor statistics. The 30 forms shown are explained in the accompanying text. Together, they form a running story of all necessary operations, from requisitioning help to the final report of hiring.

French Industrial Organization. 658.16
(Why Our Workmen Produce 30 Per Cent More Than They Did.) Emile Romanet. *Factory*, December 1924, v. 33, pp. 782-785. Brief description of the scheme of social and industrial organization of the Joya works. A feature is a works council and technical committees which establish frequent contact between working men and management.

Labor Turnover (The Other Side). 658.3126
William Davenport. *American Machinist*, January 8, 1925, v. 62, pp. 53-54. The cost of labor turnover to the employee.

Lynn Plan of Shop Representation. 658.31513
Stanley S. Ringer. MANAGEMENT AND ADMINISTRATION, February 1925, v. 9, pp. 163-164. Operation and results of General Electric Company's plan from an employee's viewpoint.

The Philadelphia Rapid Transit Co-Operative Plan—a Critical Survey. 658.3151
D. D. Kennedy. *Industrial Management*, December 1924, v. 68, pp. 367-372. Explanation of the plan; its past, present, and future.

Problems of Citizenship. 323.6
Hayes Baker-Crothers and Ruth Allison Hudnut. Henry Holt and Company, New York. 514 pp. $2.75. A comprehensive book, discussing the more important problems affecting citizenship. These problems are: The newspaper, immigration, negroes, women, industry, civil liberty, international relations, and war and peace. Each of these subjects is discussed at some length in an interesting manner, which leaves the reader with a much keener appreciation of the problems that will affect our future progress.

Sweetening Sour Employees. 658.31254
J. F. Weedon. *American Gas Journal*, December 20, 1924, v. 121, pp. 1283-1284, 1302. Forestalling the growth of discontent among employees who do not advance in position.

Three Factors Vital in Hiring an Executive. 658.31242
William L. Fletcher. *System*, December 1924, v. 46, pp. 712-715, 744-746. Size, capacity, and temperament are important, but often neglected, factors in determining suitability of applicant for job.

Training the Foundry Apprentice. 358.3862:671
R. A. Peebles. *Iron Trade Review*, December 11, 1924, v. 45, pp. 1570-1573, 1578. Illus. Outline of course given in plant of Mesta Machine Co., and records used.

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Accident Prevention in the Texas Company. 658.3823
(Why the "T" in Texaco Emblem Is Green.) George Earle Wallis. *National Safety News*, January 1925, v. 11, pp. 5-8, 41. Methods developed during ten years of safety work.

Analysis of Power Punch Press Accidents. 658.3823
Bernard L. Shientag. *Department of Labor, State of New York, Special Bulleton No. 31*, pp. 25. Illus. From the analysis of 100 accidents, suggestions are made for the construction and installation of suitable mechanical guards.

Causes of "Textile" Accidents. 658.382301
Glenn W. Cook. *National Safety News*, January 1925, v. 11, pp. 23-24.

Industrial Accidents (A Place for Safety). 658.3823
Lewis A. DeBlois. *Mechanical Engineering*, January 1925, v. 47, pp. 34-36. A general discussion of the Accident-Prevention Movement emphasizing statements: (1) Accidents lower production efficiency; (2) Accidents tend to promote development so long as the experience gained thereby is worth while.

Occupational Disease and Injury (Is the Company to Blame for Occupational Disease and Injury?) 658.3822
John Simpson. *Gas-Age Record*, December 6, 1924, v. 54, pp. 799-800. Outlines of three cases recently tried in the courts whose decisions will in all probability be used as reference and precedent in future cases of employee injury and disease.

The Safety-First Movement and Its Importance in the Factory. 658.3823
Eric N. Simons. *Mechanical World*, December 19, 1924, v. 76, pp. 391-393.

Safety Work in the Car Department. 658.3823
W. A. Clark. *Railway Mechanical Engineer*, December 1924, v. 98, pp. 744-747. Illus. Methods which prevented all but one accident over a period of 34 months, or 2,412,800 man-hours of work, in the Duluth, Missabe and Northern Works at Proctor, Minn.

Securing Proper Fire Protection for Timber Treating Plants. 658.284
Railway Engineering and Maintenance, December 1924, v. 20, pp. 487-489. Elements of danger, and recommended practices and equipment to prevent losses.

Wages

Burroughs Differential Wage Plan. 658.3231
V. R. Bechtel. MANAGEMENT AND ADMINISTRATION, February 1925, v. 9, pp. 135-138. Details of a wage plan that has proved to be simple in operation, fair to employees, and profitable to management.

Maintaining Proper Piece Rate Prices. 658.3231
L. J. Stoddard. *Forging—Stamping—Heat Treating*, December 1924, v. 10, pp. 446-447. Illus. Ability to estimate correctly the given weight of pieces to be forged, production per hour, and to apportion the cost properly, is essential to success.

Making a Bonus System Pay Dividends. 658.3225
A. W. Rowley. *Industrial Management*, December 1924, v. 68, pp. 357-361. Designing and operating of an incentive method of wage-payment.

The Pay-Roll Dollar in Industry. 658.31
S. F. Fannon. *Forging—Stamping—Heat Treating*, December 1924, v. 10, pp. 448-451. Vital importance of the human element compared with the apparent importance of plant equipment.

Systems of Payment. 658.3235
Alexander Rothert. *Engineering Production*, December 1924, v. 7, pp. 354-356. Comparative analysis of piece rate, Halsey and Rowan premium plans with recommendation for Halsey 100 per cent premium in factories where time studies are unavailable.

Financial and Accounting Control

Accounting

Accounting for Surplus. 657.372
P. W. Pinkerton. The Ronald Press Company, New York. 120 pp. $1.25. Discusses the nature of surplus and both the theory and practice of properly accounting for it in financial records. Various types of surplus are described and the particular accounting procedure applicable to each is outlined.

Accounting in Pulp and Paper Mills. 657:676
Thomas J. Burke. *Paper*, December 25, 1924, v. 35, pp. 405-407. Segregating fixed assets to get correct costs and proper estimation of receipts and expenditures are important accounting factors.

Cost Accounting for Shop Work. 657.452
Gaylord G. Thompson. MANAGEMENT AND ADMINISTRATION, January 1925, v. 9, pp. 67-70. Simple and accurate methods of accounting for shop costs.

Costing and Time-Booking. 657:452
F. A. R. Paton. *Engineer*, December 5, 1924, v. 138, pp. 633-634. How lack of identification scheme for machine parts led to incorrect filling in of time cards and hence incorrect costs; the remedies adopted.

Costing for a Non-Ferrous Foundry. 657.452:673
Arthur H. Ripley. *The Cost Accountant*, November 1924, v. 4, pp. 189-192. General outline of cost accounting procedure applicable to foundry operation.

Depreciation. 657.42
R. B. Kester. The Ronald Press Company, New York. 105 pp. $1.25. A discussion of the causes of depreciation and the factors of rate determination. Includes descriptions and appraisals of the various methods of calculating depreciation and makes specific suggestions concerning the recording of depreciation on the books. The final chapter gives a number of problems involving the application of the principles of depreciation.

Estimating Contract Work. 658.721
D. S. Cole. *Industrial Management*, December 1924, v. 68, pp. 373-376. Illus. A short-cut for the small manufacturing plant which handles parts orders from large concerns.

Factory and Foundry Accounting. 657.452
G. G. Thompson. MANAGEMENT AND ADMINISTRATION, February 1925, v. 9, pp. 169-172. Concluding article of a series dealing with cost accounting methods used in a medium-size plumbing goods factory.

Modern Accounting Systems. 657
W. D. Gordon and Jeremiah Lockwood. John Wiley and Sons, New York. 453 pp. $4. Outlines typical accounting systems used in various types of business enterprises, giving for each a summary of the records necessary and the method by which they are secured and used. Manufacturing accounts have not been given much space. Building and loan associations, insurance companies, banks, stock brokerage houses, department stores, gas companies, railroads, and municipalities are discussed.

A Practical Cost Accounting System for Paint Factories. 657:667.6
Don Gillies. *Commerce Journal*, December 1924, v. 4, pp. 21-24.

Proceedings Second Annual Chicago Conference Uniform Accounting. 657
Chamber of Commerce of the United States, Washington, D. C. 66 pp. 25 cents. A report of the progress made in various industries in preparation and installation of uniform cost accounting systems. Information contained will be valuable to all business men interested in the subject.

Putting Interest in Proper Place in Production Cost. 657.452
J. P. Jordan. MANAGEMENT AND ADMINISTRATION, February 1925, v. 9, pp. 145-148.

Standard Costs as an Aid to Profits. 657.452
G. Charter Harrison. MANAGEMENT AND ADMINISTRATION, January 1925, v. 9, pp. 41-45. Advantages of and mechanisms of operation for cost system based on the principle of exceptions.

The Way We Get Accurate Costs. 657.452
Charles Forbes. *System*, January 1925, v. 47, pp. 60-64.

Financial Control

Administrative and Selling Costs, Their Nature and Distribution. 657.452
W. H. Higginbotham and Andrew Stewart. *National Association of Cost Accounting Official Publication*, January 2, 1925, v. 6, p. 18. Deals with the nature and distribution of selling costs from the British viewpoint. From the Annual Conference of the British Institute of Cost and Works Accountants.

The Administration of the Budget. 658.14
Harry C. Semour. *National Association of Cost Accountants Official Publications*, December 15, 1924, v. 6, p. 9. Treats of the organization and operation of a budget system from the point of view of the coordinating function.

Bankruptcy. 347.7
S. F. Brewster. The Ronald Press Company, New York. 94 pp. $1.25. This volume provides a concise working manual for the business man. The rights, duties, and liabilities of bankrupts and their creditors are clearly indicated. Particular emphasis has been given to those sections of the statute that concern the rights of creditors, but the entire subject has been treated fully and practically.

Common Stocks as Long-Term Investments. 332.6
E. L. Smith. The Macmillan Company, New York. 129 pp. $1.50. The popular belief that, for safety and regularity of income, high-grade bonds are better investments than common stocks is severely shaken in this book. The author has taken a number of groups of common stocks, chosen so as to eliminate present knowledge and even in violation of ordinary investment precaution, and has compared their returns with those of an equivalent amount of high-grade bonds. Over three different 20-year periods he has found that the stocks not only provided a larger income throughout the test period, but at the end their market value had greatly appreciated over that of the bonds.

Consolidated Tax Returns. 336.2
Ralph H. Allen. MANAGEMENT AND ADMINISTRATION, February 1925, v. 9, pp. 121-124. Since 1922 the U. S. Treasury Department has only permitted corporations to file consolidated returns when there were certain legal inter-control of the stock. This procedure, if continued, will increase federal corporate taxes in many cases. Objections and arguments opposing this procedure are given.

Financial Statements for the Executive. 658.14
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189-216

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217

Shop Management in Pioneer Days

Illuminating Development of Functionalization, Cost Estimating Distribution of Expense and Service to Customers

By E. W. RICE, JR.

Honorary Chairman, General Electric Company

PIONEER work in the electrical industry in the decade of 1880 was not limited to technical matters. Scientific principles were applied to the solution of new problems of management.

This was before the days of great manufacturing corporations, and there were in this country no such manufacturing establishments as at present. Even in the old mechanical and steel-making arts and other enterprises, the factories were of relatively small size compared with modern conditions. In manufacturing, the usual organization consisted, as at present, of a board of directors, a president, secretary and treasurer. The manufacturing operation was in charge of a superintendent, who handled directly all the questions of manufacturing, including production, costs, accounting, construction, engineering supervision, etc. If the business was large enough, he would have an assistant superintendent. Of course, there would be the requisite number of foremen and assistant foremen. The assistant superintendent represented the superintendent in his absence. It was customary for all questions of discipline, production, inspection, and what would now be called engineering, to be handled by the superintendent, through the foremen. This required that the foreman be a man of unusual capacity and ability in many lines, and, like the farmer, "know everything"—a true "jack of all trades" but not necessarily "master of none."

E. W. RICE, JR.

This was naturally the situation in the factory of the Thomson-Houston Company at Lynn in its early days when we had but a few hundred employees. The period between 1884-1890, however, was one of rapid technical development and physical expansion. The number of employees rapidly grew from about 100 men to over 3500. We added to the original series arc system the manufacture of incandescent lamps, street railway apparatus, industrial motors, multiple-arc D. C. dynamos, alternating current dynamos and motors, transformers, meters, instruments of all sorts—in fact, a complicated and varied line of electrical apparatus.

We found by experience that the old system of management was unsatisfactory and proceeded to apply scientific methods to the solution of the problem. This was long before the term "scientific management" was used. We arranged to divide the work along functional lines. The superintendent took the position of factory manager of all operations, with special supervision of the purely electrical work. The work was then divided among several assistants along natural functional lines. The mechanical work, factory discipline and new building construction and maintenance were placed in charge of a mechanical superintendent; all matters of production, in charge of another new assistant, called a pro-

duction manager. The accounting, bookkeeping, pay-roll and cost accounting were placed in charge of a manager of costs; purchasing, under a purchasing agent. All of these men reported directly to the factory manager and had full power over their respective fields of operation.

This was a great experiment, and there was considerable doubt, particularly in the minds of the older men, whether the new plan could be made to operate, as it apparently detracted from the duties, and unduly restricted the authority, of the superintendent and the foreman, the sole source of authority in the old-type organization.

Early Adoption of Functionalization

These changes were made about 1884-1886, and were, so far as I am aware, the first instance of the adoption of the so-called functional system of factory administration. Naturally there were many problems to overcome, and friction would have resulted had there not been a determination on the part of all to give the new system a fair trial. It was necessary for each manager to display patience, tact, and fairness, and to meet the other fellow more than half way, but this was accomplished and all soon learned to pull together.

This system of management, which we believe was first put into active and extensive use in the Lynn Works, was entirely successful and is now generally followed not only throughout our own organization, but in all large-scale manufacturing. Whether or not we were the first to adopt the method, it was certainly original with us, and was developed without reference to any precedent, as no precedent could be found.

During this period, we also worked out and put into operation, we believe for the first time, a scientific system of estimating factory costs. Before this new plan was adopted, we had followed the prevailing custom of other manufacturing organizations of the time, which was to estimate the amount and cost of the material entering into a given article and to determine the amount of labor directly performed, but the great mass of indirect labor and other items of expense were largely guessed at and roughly covered by simply doubling the direct labor item. It was not customary as a rule to vary the percentages with the class of article, large and small, or to determine with any accuracy the distribution of various expense items.

Allocation of Overhead

We developed a method by which all the items of expense—indirect labor, taxes, insurance, coal, shipping, purchasing, office expense, wastage, maintenance, depreciation, etc.—were carefully segregated and an attempt made to determine scientifically the manner in which these items varied with the material and with the direct labor in every important line or article of manufacture.

It was clearly shown as a result of this study that some expense items were a function of labor alone, others of material and others again varied as a sum of material and direct labor. We, therefore, developed a method by which we added to the material a definite per cent, to direct labor another definite per cent, and to the sum of labor and material, still another per cent.

This system required the use of three percentages, and while it was believed to give the most accurate and scientific results, it was not generally installed, because it was believed to be too complicated and probably too much in advance of the times for general adoption. We, therefore, modified the method by the adoption of two percentages, one rather moderate and added to the material and the other, much larger, and added to the direct labor—the system, in fact, which we now have in general use.

The electrical industry has made magnificent contributions to the wealth, comfort, and happiness of the people. If he who "makes two blades of grass grow where but one grew before" is to be regarded as a public benefactor, then the men of the electrical industry deserve to be acclaimed the world's master benefactors.

Electrical Industry's Service

In addition, I believe that the electrical industry may be credited with something better, finer and more precious. They have taken the lead in the practice of the higher ideals in business which has taken place to a notable extent during the past 25 years. They have stimulated, if you please, the moral sense, brought about a more extended application of the old adage that honesty is the best policy, and have shown it to be, in fact, the only policy. They have changed the idea of the practical economist of the old school as to the relation between buyer and seller exemplified in the old adage of *caveat emptor*—let the buyer beware. They have substituted the spirit of scientific service to the customer which has inspired his confidence and brought about a co-operation that has been one of the greatest factors in the rapid development of the electrical business.

I have said elsewhere that I do not believe that we care to claim that electrical men are naturally more honest or sincere or saintlier than others, and that, in my judgment, the reason they have taken the lead in this remarkable improvement of the business conscience is to be found deeply rooted in the very nature of our business itself.

As our electrical business developed, every day, every hour, saw the birth of a new wonder, some new force which was quickly put to work for the benefit of all the people. Truth was found to be not only stranger than fiction, but more beautiful, more profitable and more satisfying to the best instincts of human nature, so that, breathing the pure and stimulating air of scientific truths, the electrical business became the natural and unchallenged leader in higher business and human ideals. I think, therefore, we may all be permitted to take honest pride in our record, and that the younger men may look forward to even greater contributions to the material, intellectual and moral welfare of the world than we older men have dared to dream of in the highest flights of our imagination.

The Ford Engineering Laboratory

A Great Institution for Industrial Research and Experiment

By GEORGE E. HAGEMANN

Associate Editor, MANAGEMENT AND ADMINISTRATION

THE Ford Motor Company has just completed and moved into a large and most efficient laboratory, probably the most beautiful of its kind ever constructed for a manufacturing industry. In purpose, size, design and equipment, this building is an institution—the physical expression of an ideal put into practical form and ready to serve the individual, the factory, farm, and business, the state, the nation, and the world.

It is located at Dearborn, Michigan, and forms the central point at which are concentrated the main engineering, research and experimental activities connected with the making of Ford products. At each Ford plant, of course, research and experimental work are carried on to meet the local needs. But there must be some controlling center to co-ordinate and direct the vast spread of undertakings, and to originate much of the work which later on can be applied and carried to a practical conclusion in the individual manufacturing plants.

Reason for Choice of Location

Dearborn, the site of the new laboratory, is 11 miles from the parent organization at Highland Park, 5 miles from the newer plant at River Rouge, and 7 miles from the Lincoln plant; hence it is in close proximity to the main production units of the company. At Dearborn the Fordson tractor formerly was made, although now this work has been transferred to the River Rouge plant.

Not far away is the old homestead where Henry Ford was born and spent his early years. Nearby are the extensive farms, themselves great outdoor laboratories in which his ideas, conceived in youth, to remove the drudgery from agricultural pursuits, are daily experimented with and carried to further fruition. On the ground where now the laboratory building stands was located the brickyard in which he first saw practical illustration of mechanical methods of manufacturing—a brick-making machine.

Moreover, Mr. Ford's residence is at Dearborn, and he keeps in close personal touch with the work of the laboratory. Through it he directs improvements in design and construction of the company's products, as well as agricultural and transportation developments. During each week several thousand inquiries are directed to him from all parts of the world, asking legitimate questions on manufacturing, transportation, agriculture and other subjects, and all of these are answered with the best information available. Many of these inquiries necessitate special investigations and perhaps experiments before they can be replied to. Some few will require research of an extensive nature. So long as a request for information is not idle curiosity, but a search for information of help in the daily productive work of the inquirer, it is carefully and completely answered.

The general design of the building harmonizes with the great central idea which it typifies. Architecturally it conforms to the type of construction usually adopted for museums, libraries and public buildings, as shown in Fig. 1. It covers an area of 804 by 202 ft. and is one story high—a standard adopted wherever possible

FIG. 1 NEW FORD LABORATORY AT DEARBORN FOR RESEARCH AND EXPERIMENTAL WORK

for all structures built by the company. The middle section along the front, occupied by the offices, is, however, two stories high. A basement extends beneath the entire structure.

Features of the Building

The building is constructed on a steel framework. The exterior is of white Bedford limestone, ornamented with fluted columns at the entrance, panel columns at the corners, and medallions and simple carvings over the windows and between the panels. Above the entrance is a bas-relief bearing this inscription:

> **Mankind passes from the old to the new on a human bridge formed by those who labor in the three principle arts—Agriculture—Manufacture—Transportation.**

Flanking this on each side are two symbolic figures. One holds a Ford sedan and another a Fordson tractor.

Along the front of the building below the roof, which is of red tile, are carved the names of 20 men and one woman famous in science, engineering or invention: Darwin, Ampere, Da Vinci, Franklin, Fulton, Whitney, Bell, Marconi, Wright, Burbank, Edison, Burroughs, Kirby, Diesel, Faraday, Mme. Curie, Newton, Pasteur, Galileo, Dunlop, and Otto.

The front entrance leads into a spacious lobby and back of this is a corridor upon which the ground floor rooms open. Offices for Henry and Edsel Ford and the executive engineers, and the editorial departments and business offices of *The Dearborn Independent* are located on this floor. On the second floor are located the general offices of the Dearborn Publishing Company and an extensive reference library.

Main Laboratory

The main laboratory section is one story high, the clear height at the peak of the roof trusses being about 30 ft. There is added significance to the one-story type in the case of an industrial laboratory. Research and experimentation are largely successive-process operations. One part of the work fits into another. The possibility of a physical arrangement of equipment and workers which will follow out the sequence of performance in logical progression brings about an orderliness, a close intercommunication, a visualization of the work, and a control of activities not possible where the work is distributed over several floors. Moreover, no one can foresee what developments may take place which will necessitate a radical rearrangement or change of equipment. With a single floor to deal with, such changes can be readily made. A nearby railroad siding and a wide doorway at the end of the building make it convenient to move apparatus in and out quickly when changes are necessary, and a craneway has been provided down the middle aisle (see Fig. 2) to enable machinery to be handled by mechanical means when necessary.

The interior view shown in Fig. 2 looks toward the front and upper end of the laboratory. Except for columns, and the offices in front, the entire floor is clear, partitions being purposely omitted because they are unnecessary and would detract from both the appearance and the utility of the building.

The concrete columns, spaced on about 45 ft. centers lengthwise and 40 ft. centers crosswise of the building, support girders holding the special arch-shaped steel roof trusses. These trusses are on 10 ft. centers and frame in the inclined windows along the roof structure through which a flood of daylight falls on the floor below. The windows along the sides and ends of the buildings also admit abundant light. The total window area of 64,000 sq. ft. is 40 per cent of the floor area. On a normal day fine work can be performed in any part of the vast room without the aid of artificial illumination.

The floor is polished maple, in keeping with the beauty and refinement of the rest of the building.

Heating and Ventilation

This same idea of harmonizing every service feature of the laboratory into a uniformly beautiful building has been followed out in the heating and ventilating arrangements. The high type of work to be performed in the laboratory calls for correct room temperature and careful conditioning of the air supplied for ventilation. In the basement are large steam heating coils supplied from the power house adjacent to the laboratory. Air is drawn in from outside the building, washed and conditioned, passed over these coils and thence is led by means of ducts to all parts of the building. Distribution is accomplished through grills in the building columns, which discharge the air at a height of 7 ft. from the floor. Thus economy of space, efficient circulation, and a pleasing appearance are obtained coincidentally.

The building is also heated by steam radiators placed along the outside walls under the windows. This location is the best from the standpoint of space occupied, effective heat circulation and the good appearance of the room. Temperature control is maintained by means of thermostats.

Artificial lighting is furnished by means of electric fixtures suspended from the ceiling. Along the 5 roof arches, and also the lower portions of the ceiling at the base of these trusses (except down the middle bay) these fixtures are located at 20 ft. intervals. In the middle bay 2 rows of lights are hung from the upper part of the trusses, the craneway preventing the hanging of lights below. Each fixture will carry a 500 watt Mazda Type "C" bulb. For every longitudinal section of the building, the lights are thus spaced at 20 ft. centers each way and will provide ample illumination for the finest work on drawing board or machine. All wiring is concealed and the lighting equipment is quite ornamental.

Location of Departments

Referring again to Fig. 2, the near end of the main laboratory is occupied by the designing and engineering departments. The middle of the room contains

the machines which make the thousands of parts required for the experimental car, truck and tractor models, parts for new designs of machines, and research equipment designed in the adjacent engineering department. These machines comprise lathes, planers, punch presses, drill presses, milling machines, grinders, and numerous pieces of equipment of special design. Each is motor-driven, the wiring coming through the floor beneath the machine to eliminate all unsightly overhead power lines and be out of the way of work.

FIG. 2 INTERIOR VIEW LOOKING TOWARDS THE FRONT OF THE LABORATORY

Research Procedure

New designs of parts are tried out and their utility determined from the standpoint of reducing manufacturing costs, simplifying methods of processing, and supplying the customer with a better and at the same time less costly product. It is neither social nor industrial economy to change fundamental designs and models of cars more rapidly than normal use would tend to wear them out. But it is economy and good business to strengthen the parts of cars and make them more resistant to wear and tear. So the laboratory moves slowly on basic changes in car design, but rapidly in improving the parts.

The following quotation[1] clearly and concisely states the policy of the company in its experimental and research work on new equipment:

> One reason for the extreme modernity of all Ford methods is Mr. Henry Ford's willingness to back his judgment and that of his engineers with the investment necessary to carry the work to completion. The Piron low temperature coking process required the spending of millions long before the first oven was filled. The first turbo-generator at the River Rouge power plant represented an investment of a million dollars before it made a single revolution. If a new discovery will reduce operating costs, or produce better work, the Ford Motor Company will adopt it even though it means the virtual scrapping of hundreds of thousands of dollars' worth of equipment, for any economies made possible will be multiplied by millions and soon write off the investment. The Company, however, sticks to its own field and deals only with things bearing on the Ford industries.

Although probably 500 inventions and processes are submitted by outsiders weekly for consideration, and those of real merit are investigated and accepted, if of value, the company, by employing experts, has been able to develop practically all of its designs of product and methods of manufacture within its own organization. The policy is not a narrow one, however, because sample cars from all representative American and foreign makers are constantly being brought into the laboratory and thoroughly investigated, to search for possibilities of improving Ford products.

In the far upper right-hand corner of Fig. 2 is the section given over to dynamometer tests of machinery and cars. Along the front of the building at this end are the three new printing presses for the weekly magazine. All work on this publication, except the engraving of cuts (done outside) and electrotyping will now be performed in this laboratory building. Monotype equipment is in process of installation. The printing presses are built on foundations independent of the building, a space of 18 in. separating each of them from the main floor of the building and preventing transmission of vibration to the laboratory floor.

Chemical and Metallurgical Research

In addition to the physical side of research and experimentation now provided for, an extensive chemical and metallurgical laboratory will be installed in the building. The Ford car is made up of 40 different steels, 5 kinds of cast iron, 12 varieties of bronze, 8 kinds of brass, 4 aluminum alloys, 3 different babbitt compositions, pure lead, and pure copper, or a total

[1] "The Ford Industries," published by the Ford Motor Company, December 1924, p. 108.

of 74 metals or different combinations of metals. There is not only an opportunity but a positive necessity to undertake original work in the study of these metals, if the industry is to keep ahead of the times.

The Fordson tractor connects the industry with agriculture and, in addition, one of the by-products of coal distillation at River Rouge is ammonium sulphate, a fertilizer. Hence there arises a need for extensive agricultural research, both chemical and botanical. Part of this is done inside the laboratory and part on the Ford farms adjacent, where, also, agricultural machinery is subjected to practical tests and investigations.

Equipment in the Basement

In the basement of the building, extending underneath the entire floor area, are the service facilities—washrooms, lockers, showers, toilets—beside extensive storerooms for supplies, paper for the presses, etc.

The basement also connects with a tunnel 175 ft. long leading to a railroad siding near the laboratory. Through this tunnel a conveyor brings in the rolls of paper used to print the publications. The quantities involved are large, for the circulation of the weekly totals in the neighborhood of 650,000. The printed magazines are wrapped, bagged, or bundled, for shipment or mailing, and lowered to the basement. where another conveyor carries them to the railroad siding.

In the old building, formerly occupied by the tractor plant and now adjoining the laboratory, is an industrial museum whose exhibits are mainly of American origin. History forms a valuable stimulus to future progress, for the present learns from the past. The vehicles and appliances forming the bulk of the objects in this museum are related to present-day Ford products, hence are something more than an interesting collection of relics.

Highway transportation is represented by conveyances ranging all the way from the American Indian's travois, through the stage coach and all types of carriages and wagons, to the first Ford and its consecutive models, including those of the present day. Agricultural progress is typified by mowing machines of all important periods of development, and various other kinds of farm machinery. The progress of ideas leading to the modern tractor is visualized by the crude steam engine of the 50's and its successively improved types down to the Fordson, a mobile, tractive power plant. All of this equipment has been of inestimable aid in guiding Ford engineers and visiting experts working on new ideas in these fields.

Far-Reaching Importance of the Laboratory

Built primarily for research and experiment in agriculture, manufacturing and transportation, the laboratory fulfills a mission of even wider scope and importance. Its first duty, of course, is advance research, to keep the company ahead instead of merely abreast of the times. It must discover new uses and open up new outlets for the application of Ford cars, trucks and tractors, and better combinations of materials and methods of manufacture. But it will also function in the conservation of materials and the prevention of waste because of the improved and more lasting products which it will develop.

While the results accomplished in furthering the use of products and in preventing waste return millions annually to the Ford Motor Company, they eventually benefit the consumer in price reductions, other manufacturers through the unselfish way in which helpful information is passed along, and the nation at large in the conservation of physical resources. A vast amount of data not directly connected with automobile making is collected by the laboratory in the course of its work, and it is this fund of information which is drawn upon to answer the thousands of inquiries which come in from the agricultural, manufacturing and transportation interests, to aid in social and industrial economy.

Secondly, the idea of retention and correct application of factors valuable to industry has not been limited to materials and methods alone, but extends to the men and women who deal with these things. In this work the laboratory will accomplish results of immeasurable benefit to the health, happiness and prosperity of the 150,000 Ford employees, and indirectly the great body of workers in American industry as well.

Testing Every Package of Chemicals

CHEMICALS coming into a factory of any kind for use as raw material or in processes are usually very important in their action, and test methods should be installed as thorough and effective safeguards against receiving and using the wrong material.

The United Drug Company in its factory uses a great number of chemicals, and has routine methods for making sure that each drug used is the correct one and of the correct strength and specifications. When a shipment of a given drug is received, the samples of the shipment are taken, not from the shipment as a whole, but from each container, whether a jug, tank, barrel, box, or other package. The container or package is identified with a number which is also recorded on the sample taken from it. Each of these samples goes to the chemical inspection department where it is put through an analysis and compared with the original purchase orders of that shipment. The analysis, if correct, is then O K'd by the inspection department. A copy of the O K is fastened upon the individual package.

No package is available for use by the manufacturing department unless it has such an O K from the inspection department. There may be a considerable quantity of the desired material in the receiving room and possibly in stock; but if each package is not officially O K'd by the inspection department, it is not in stock so far as manufacturing is concerned.

To check up this O K, another inspection is made when the material reaches the manufacturing department, and before it gets into production.

Financial Statement Analysis

A Comparison of Methods

By SPENCER B. STEVENSON

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INDUSTRIAL managers, business executives, bankers, and others are constantly confronted with the problem of interpreting financial statements in order to formulate policies or to judge the present and prospective soundness of a business. To facilitate such interpretation, a number of methods of analysis have been proposed. Among them are those described in the articles entitled "A Method of Balance Sheet Analysis" by Stephen Gilman,[1] and "Balance Sheet Analysis" by Alexander Wall,[2] and in J. H. Bliss's books "Financial and Operating Ratios in Management" (1923) and "Management Through Accounts" (1924).

The purpose of this article is to compare the several methods proposed, from the viewpoint of practical utility in judging the condition of a business, and to contribute some independent thoughts on the development of the subject toward that end.

Ratio Method

In brief, by the ratio method, two elements whose relationship to each other is considered to be of importance are expressed by dividing one into the other and expressing the result decimally. Following is a comparison of the ratios advocated by the writers whose views are now under consideration:

Ratio	Proposed by		
Current assets to current liabilities	Gilman	Wall	Bliss
Sales to accounts receivable	Gilman	Wall	Bliss
Sales to inventory	Gilman	Wall	Bliss
Sales to fixed assets	Gilman	Wall	Bliss
Sales to net worth	Gilman	Wall	....
Net worth to fixed assets	Gilman	Wall	....
Net worth to debt (total liabilities)	Gilman	Wall	....
Inventory to receivables	.....	Wall	....
Sales to total assets (total capital employed)	.....	....	Bliss
Operating profits to total assets (total capital employed)	.....	....	Bliss
Gross earnings to sales	.....	....	Bliss
Expenses to sales	.....	....	Bliss
Operating profits to sales	.....	....	Bliss
Net profits to sales	.....	....	Bliss
Net profits to net worth	.....	....	Bliss
Earnings left in business to net income	.....	....	Bliss
Various classes of assets to total assets (to emphasise manner in which capital is invested)	.....	....	Bliss
Various classes of liabilities to total liabilities (to emphasize sources from which capital is drawn)	.....	....	Bliss

It will be observed that many of the ratios listed, especially among those advocated by Bliss, do not relate entirely, or in some cases at all, to the balance sheet. It will also be noted that none of the ratios suggested by Gilman and Wall deals with profits, either operating or net, or with expenses. This may be because their articles were intended to consider balance sheet analysis only, though sales figures were introduced to permit the calculation of turnover rates. An income statement should accompany any balance sheet to enable a satisfactory analysis to be made, but where such statements are not available, figures for profits are to be had far more frequently than are those for sales. There would seem, therefore, to be no practical reason for failing to consider the profit-earning capacity of a business in analyzing its financial statements.

Considerable difference of opinion exists at present as to which of the relationships expressed in financial statements are of outstanding importance. In this article, however, direct comparison of the methods of analysis suggested by Gilman and Wall will be limited to those relationships which have been treated in both of their articles. It will be made by presenting analyses, according to each method, of condensed data taken from published balance sheets and income statements of a widely known industrial company. An analysis of the same data (represented by Table 1) will then be made, using, in the main, the method advocated by Bliss, but introducing certain additional features.

The details of net worth, as between various classes of capital stock, appropriated surplus, and free surplus, have not been stated in Table 1, as these details are not germane to this discussion. In practice, however, they should of course be shown.

The ratios under discussion calculated from these balance sheets are shown in Table 3. Certain of them are sometimes expressed differently. For example, the current or working capital ratio may be expressed by stating current assets as 428 per cent of current liabilities or by stating that there are $4.28 of current assets to each $1 of current liabilities. Similarly, the ratio of sales to accounts receivable may be stated, as in Table 3, as a percentage, or as the number of average days' sales, represented by outstanding accounts. The aim should always be to use the more familiar term when no principle is violated by doing so.

Method Advocated by Gilman

The method advocated by Gilman, which he describes as the "index method," consists simply of using each item of the first date of the series, December 31, 1919, as a base, and dividing the corresponding items of the succeeding periods by it. The resulting quotients show the ratio of each item to the base, and hence the extent of variation from that base.

Table 2 is an analysis by this method of the financial

[1] MANAGEMENT AND ADMINISTRATION, August 1924, p. 147.
[2] MANAGEMENT AND ADMINISTRATION, November 1924, p. 521.

TABLE 1. CONDENSED BALANCE SHEETS AND INCOME STATEMENTS

for the five years ended December 31, 1923, X. Y. Z. Company

	1919	1920	1921	1922	1923
Assets					
Accounts receivable	$ 88,193	$ 138,725	$ 63,643	$ 87,231	$ 95,799
Inventories	226,797	258,363	241,504	220,707	270,758
Other current assets	357,305	305,282	264,284	204,265	222,038
Total current assets	$ 672,295	$ 702,370	$ 569,431	$ 512,203	$ 588,595
Fixed assets (less depreciation)	1,573,662	1,606,759	1,644,795	1,631,579	1,639,159
Other assets	119,925	121,418	124,879	196,871	193,129
Total assets	$2,365,882	$2,430,547	$2,339,105	$2,340,653	$2,420,883
Liabilities and Capital					
Current liabilities	$ 157,071	$ 156,745	$ 84,249	$ 98,754	$ 137,403
Bonded and debenture debt	568,728	554,828	540,706	539,582	527,035
Other liabilities	167,552	186,036	195,741	193,695	194,211
Total debt	$ 893,351	$ 897,609	$ 820,696	$ 832,031	$ 858,649
Net worth	1,472,531	1,532,938	1,518,409	1,508,622	1,562,234
Total liabilities and capital	$2,365,882	$2,430,547	$2,339,105	$2,340,653	$2,420,883
Condensed Income Account					
Sales	$1,448,558	$1,755,477	$ 986,750	$1,092,698	$1,571,414
Expenses	1,300,886	1,563,754	939,720	1,032,958	1,407,097
Profits from operations	$ 147,672	$ 191,723	$ 47,030	$ 59,740	$ 164,317
Net income	$ 76,795	$ 109,694	$ 36,617	$ 39,653	$ 108,707

statements represented by the data given in Table 1.

Gilman contends that this method is superior to the so-called "ratio" method, previously described, in that any trends of importance, whether good or bad, can be detected easily and quickly, whereas by the "ratio" method such detection involves considerable study.

The fact is that the method he proposes, while disclosing the trends of all the items comprehended in the statement, casts upon the reader the burden of picking out those of greatest significance. Moreover, and more important, it lays upon the reader the further burden of associating in his mind those items which Gilman admits should be considered in their relation to each other. It is questionable if the majority of persons who may be called upon to interpret financial statements are possessed of the degree of knowledge of accounts and figures which the mental computation of the ratios would require, even though they may be aware of the significance of such ratios when they are stated.

Table 2 does not indicate the various relationships, but is in reality merely a table of variations from the figures of the first or basic series. Hence, so far as it is concerned, an effort to compute, for 1923, the ratio of current assets to current liabilities would involve a troublesome computation. It is, however, a fact that if the dollar figures were stated with the index numbers beside them this difficulty would be obviated, and the calculation could be made directly from the dollar figures.

Further objections are:

1. The "index method does not provide any angle of view beyond that afforded by the dollar figures themselves; it merely facilitates comparison of the variations in the dollar figures.
2. It does not lend itself to comparative analysis of the statements of different companies.
3. It to some extent implies that the first or basic series represents a normal or an ideal condition.

With respect to the first of these objections, it may be remarked that to a considerable extent statistical methods of presenting information merely reduce masses of unwieldy data to a basis upon which they may be grasped with less difficulty. This objection is therefore not of paramount importance.

With respect to the second objection, Gilman's proposed method is stated by him to be intended for the analysis of successive balance sheets of the same company. He urges that the great difficulty of obtaining reliable data with respect to a considerable number of concerns engaged in the same business renders of little value the effort to develop standard or characteristic ratios with respect to various industries. It would seem, however, that even fragmentary data of this character, when used with judgment, are of assistance in comparing companies in the same industry and with other common characteristics; furthermore, the difficulty of developing characteristic ratios will doubtless be minimized with the passage of time.

The third objection, that the use of the figures of the first of the series as a base implies that such figures are normal or ideal, is expressly denied by Gilman. Nevertheless, it is probable that the inference would

TABLE 2. ANALYSIS OF BALANCE SHEETS AND INCOME STATEMENTS BY INDEX NUMBER METHOD ADVOCATED BY STEPHEN GILMAN

X. Y. Z. Company

	1919 Amount	1919 Index Number	1920 Index Number	1921 Index Number	1922 Index Number	1923 Index Number
Assets						
Accounts receivable	$ 88,193	100	157	72	99	109
Inventories	226,797	100	114	106	97	120
Other current assets	357,305	100	86	74	57	62
Total current assets	$ 672,295	100	104	85	76	88
Fixed assets (less depreciation)	1,573,662	100	102	105	104	104
Other assets	119,925	100	101	104	164	161
Total assets	$2,365,882	100	103	99	99	102
Liabilities and Capital						
Current liabilities	$ 157,071	100	100	54	63	88
Bonded and debenture debt	568,728	100	98	95	95	93
Other liabilities	167,552	100	111	117	116	116
Total debt	$ 893,351	100	101	92	93	96
Net worth	1,472,531	100	104	103	102	106
Total liabilities and capital	$2,365,882	100	103	99	99	102
Condensed Income Account						
Sales	$1,448,558	100	121	68	75	109
Expenses	1,300,886	100	120	72	79	108
Profits from operations	$ 147,672	100	130	32	41	111
Net income	$ 76,795	100	143	48	52	141

frequently be drawn that the base figures were intended as a standard. At any rate, a base composed of the average of the statements of several years would be preferable, since any abnormalities of a given year selected as a base would be minimized, and distortion of the subsequent index numbers would consequently be reduced.

Method Used by Wall

The method explained in Wall's article resembles that just described, in that it makes use of the index number method so widely employed in statistical studies. It differs vitally, however, in that the figures used express the changes in relationships from period to period rather than merely the changes in the several elements themselves.

Following is a summary of the method:

1. The ratios are computed for each date.
2. The ratios are reduced to index numbers.
3. The index numbers resulting from (2) are weighted according to their relative importance.

(1) The first of these processes requires no elucidation; following is a brief explanation of the second and third.

(2) Using the ratios of the first date of the series (in this case, December 31, 1919) as a base, the ratio figures for the remaining dates are divided by such base, the resulting quotients representing the index numbers of each ratio subsequent to the base year; that is, their percentage of the figures of the base year. For example, the ratio of net worth to fixed assets in 1919, 94 per cent, is divided into that of 1920, 95 per cent, resulting in an index number of 101. Net worth in its relation to fixed assets is, therefore, 1 per cent greater in 1920 than in 1919.

Where the increase above the basic ratio is extreme, the following formula is used in order that the weighted index (considered under process 3) may not be unduly influenced:

$$\text{Index number} = 100 + \left(100 - \frac{\text{Base ratio}}{\text{Individual ratio}}\right)$$

When extreme variations are controlled in this manner, the index number of which the base is always 100 can under no conceivable circumstances exceed 200.

No opinion is expressed in the article as to the point at which this control of deviations should be introduced, although a considerable number of the index numbers used in it were so adjusted. This question would appear to be one requiring much consideration and the exercise of no little judgment.

Wall explains that in actual practice he prefers to use as a base the average of several years' statements, since abnormalities in one year tend to be offset in other years. This method is undoubtedly highly desirable and is well recognized in the best statistical practice.

TABLE 3. ANALYSIS OF BALANCE SHEETS AND INCOME STATEMENTS BY "RATIO" METHOD WITH COMPUTATION OF COMPOSITE INDEX

By method described by Alexander Wall, X. Y. Z. Company

Summary of Relationships	Weights Used	1919			1920			1921			1922			1923		
		Ratios %	Index Numbers (Base)	Weighted Index Numbers	Ratios %	Index Numbers (Base)	Weighted Index Numbers	Ratios %	Index Numbers (Base)	Weighted Index Numbers	Ratios %	Index Numbers (Base)	Weighted Index Numbers	Ratios %	Index Numbers (Base)	Weighted Index Numbers
Current assets to current liabilities	25	428	100	25	449	105	26.3	676	137	34.2	519	121	30.2	428	100	25.0
Net worth to fixed assets	15	94	100	15	95	101	15.2	92	98	14.7	92	98	14.7	95	101	15.2
Net worth to debt	20	165	100	20	171	104	20.8	185	112	22.4	181	110	22.0	182	110	22.0
Sales to accounts receivable	10	1640	100	10	1270	78	7.8	1550	95	9.5	1255	77	7.7	1640	100	10.0
Sales to inventory	10	638	100	10	680	107	10.7	408	64	6.4	495	78	7.8	580	91	9.1
Sales to fixed assets	15	92	100	15	109	118	17.7	60	65	9.8	67	73	11.0	96	104	15.6
Sales to net worth	5	98	100	5	115	117	5.9	65	66	3.3	72	74	3.7	101	103	5.2
Total, composite summary index (base, 1919, = 100)	100			100			104.4			100.3			97.1			102.1

(3) As a final step, in order to produce a series of index numbers which when totaled will summarize, in a single figure, the relationships which have been described, the index numbers are weighted. Wall's explanation of the reason for and basis of this weighting is as follows:

> As a first step in creating an index figure came the realization that the several ratios do not have the same analytical value. In some special cases the value of one or more ratios approximates zero. For instance, in analyzing the statement of a purely trading company having almost no fixed assets, the ratios of which the fixed assets are a part are almost valueless. The question of co-relating these ratios has been experimentally solved by assigning to them varying weights on the basis of having the total weights equal 100 in each instance.

The weights shown in Table 3 were used in Wall's article though no opinion was expressed therein as to their general applicability. Undoubtedly there is room for difference of opinion concerning the suitability of these weights, hence again, as in the matter of limiting deviations from the base, there is necessity for the exercise of judgment.

In general, the method advocated by Wall, as exemplified by Table 3, recognizes fully the principle that in analyzing a financial statement the relative proportions, rather than the absolute size, of the various elements are of paramount importance. Therefore, by its first step, the ratios expressing such relative proportions are computed and a point in advance of that

finally attained under Gilman's method is achieved. The next step, in effect, expresses the variations during subsequent periods from the ratio of the period or periods treated as a base, and is of value principally as a necessary preliminary to the final step. The final step applies judgment to the figures and produces a result which indicates from year to year the position of the business on the whole. If the judgment be well-considered and sound, the indicator obtained by this method will be valuable; should it be ill-considered and unsound, it may be worthless, or, if relied upon unreservedly without examination of the details, even dangerous. It should be noted, also, that in selecting appropriate weights for the several ratios which are combined in the final composite index, recognition should be given to the difference in viewpoint between a prospective creditor and a prospective investor.

TABLE 4. SUGGESTED RATIOS, THEIR CONVERSION TO INDEX NUMBERS, AND SUGGESTED WEIGHTING FOR COMPUTING COMPOSITE INDEX NUMBERS

Using average of ratios for 1919, 1920, and 1921, as base, X. Y. Z. Company

	Weights Used	Average of Ratios 1919, 1920, 1921 (Base) %	1919			1920			1921			1922			1923		
			Ratios %	Index Numbers (Base)	Weighted Index Numbers	Ratios %	Index Numbers (Base)	Weighted Index Numbers	Ratios %	Index Numbers (Base)	Weighted Index Numbers	Ratios %	Index Numbers (Base)	Weighted Index Numbers	Ratios %	(Index Numbers Base)	Weighted Index Numbers
Current assets to current liabilities	25	518.0	428.0	83	20.8	449.0	87	21.8	676.0	130	32.5	519.0	100	25.0	428.0	83	20.8
Total assets to fixed assets	10	147.0	150.0	102	10.2	151.0	103	10.3	142.0	97	9.7	143.0	97	9.7	148.0	101	10.1
Net worth to total capital employed	15	63.0	62.0	98	14.7	63.0	100	15.0	65.0	103	15.5	64.0	102	15.3	65.0	103	15.5
Sales to accounts receivable	5	1487.0	1640.0	110	5.5	1270.0	86	4.3	1550.0	104	5.2	1255.0	84	4.2	1640.0	110	5.5
Sales to inventory	10	575.0	638.0	111	11.1	680.0	118	11.8	408.0	71	7.1	495.0	86	8.6	580.0	101	10.1
Sales to fixed assets	10	87.0	92.0	106	10.6	109.0	125	12.5	60.0	69	6.9	67.0	77	7.7	96.0	110	11.0
Profits from operations to sales	10	8.6	10.2	118	11.8	10.9	127	12.7	4.8	56	5.6	5.5	64	6.4	10.5	122	12.2
Net income to net worth	15	5.1	5.3	104	15.6	7.5	132	19.8	2.4	47	7.1	2.6	51	7.7	7.2	129	19.4
Total, composite summary index (base, average for 1919, 1920, and 1921, = 100)	100	.....	.....	.....	100.3	.....	.....	108.2	.....	.....	89.6	.....	.....	84.6	.....	.....	104.6

Where financial statements are analyzed by the method described, the task of a person examining them is greatly lightened. He is relieved of the necessity of deciding which relationships in the statement he should consider. That decision is made for him. Moreover, he is enabled, by merely glancing at the final index, to reach a conclusion as to the condition of the business which is based upon scientific and detailed analysis.

The computation of the index numbers and the subsequent weighting of them according to relative importance are largely in the nature of statistical mechanics. Figures are produced which are so unlike the original data upon which they are based as conceivably to be baffling to the non-technical reader. It is therefore desirable, in most cases where general use is to be made of the analysis, to show the original data with the ratios as computed by the first process and with the final composite index. This has been done in Table 5, later in this article.

Industrial managers are justly inclined to be impatient of mere questions of method, whether accounting or statistical, hence analyses of financial statements for their purposes should not be burdened with figures showing intermediate steps in the process of analysis. For example, in the writer's opinion it is not desirable to include the index figures shown in Table 4.

In general, the plan described by Wall may be said to apply the statistician's method of analyzing and condensing data to the problem of financial statement analysis. If extended so as to include adequate consideration of operating and profit and loss elements, it undoubtedly produces a reasonably comprehensive and sound analysis.

Bliss's Method of Analysis

Most of the ratios advocated by Bliss and the basis of their computation are indicated at the beginning of this article. Several conspicuous points of difference as compared with the ratios discussed by Gilman and Wall are apparent. In the first place, as pointed out elsewhere, neither of them has introduced any operating element other than sales. Further, in considering strictly balance sheet relationships (those not involving sales), Bliss computes the ratio of each asset or liability item to total assets or liabilities rather than to some other individual item. Thus, instead of computing the ratio of net worth to fixed assets, the ratios of net worth to total liabilities (including capital) and of fixed assets to total assets, respectively, are computed. These differences will be apparent from a comparison of Tables 3 and 4.

Table 4 shows the details of the computation of a composite index, based upon the same data as Table 3, but giving effect to the writer's opinion as to which ratios should ordinarily be included in the computation and their relative importance. Further, the arithmetical average of the ratios of 1919, 1920, and 1921 are taken as the base in computing the index numbers, whereas in Table 3 the figures for the single year 1919 are used.

The variations of the index numbers above their respective bases are adjusted in only two instances in Table 4:

	Year	*Adjusted*	*Unadjusted*
Net income to net worth.....	1920	132	147
Net income to net worth.....	1923	129	141

the index numbers representing the ratio of net income to net worth for 1920 and 1923, 147 and 141, respectively, being adjusted by using the formula previously described, to 132 and 129.

Table 4 does not exhibit the underlying financial data which are represented by Table 1. In practice, however, the writer considers that the dollar amounts should be shown since the reader would thereby be enabled to avail himself of the assistance afforded by the ratios and index numbers without loss of the specific information represented by the figures themselves. This is particularly desirable when the statements are to be used for general business purposes rather than for technical economic or statistical studies.

In Table 4 the various ratios are expressed first as percentages, then as index numbers, and finally as weighted index numbers in order to facilitate consideration of the method. In practice this profusion of detail would probably be undesirable as placing undue emphasis upon the processes rather than the conclusions, and thereby detracting from the real purposes of the investigation.

Computing the Composite Index

When computing the composite index, it is desirable that the increase of any constituent ratio should denote a favorable tendency; therefore the ratio of total assets to fixed assets (total assets ÷ fixed assets) is used, rather than that of fixed assets to total assets.

For the same reason, the ratio of sales to accounts receivable is employed rather than the number of average days' sales represented by accounts receivable. In both cases this represents an enforced departure from the more logical statement of the ratios which is exhibited in Table 5, a summary of balance sheets and income statements.

For the reader's convenience the following comparison is made of the final result, that is, the composite index, produced in Tables 3 and 4.

TABLE 5. SUMMARY OF BALANCE SHEETS AND INCOME STATEMENTS[1]

Showing analysis for general business purposes by combination of "ratio" and "index number" methods, including composite index based upon Table 5, X. Y. Z. Company

	1919		1920		1921		1922		1923	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
Assets										
Accounts receivable	$ 88,193	3.7	$ 138,725	5.7	$ 63,643	2.7	$ 87,231	3.7	$ 95,799	4.0
Inventories	226,707	9.6	258,363	10.6	241,504	10.3	220,707	9.4	270,758	11.2
Other current assets	357,305	15.1	305,282	12.6	264,284	11.4	204,265	8.8	222,038	9.1
Total current assets	$ 672,205	28.4	$ 702,370	28.9	$ 569,431	24.4	$ 512,203	21.9	$ 588,595	24.3
Fixed assets (less depreciation)	1,573,662	66.5	1,606,759	66.1	1,644,795	70.3	1,631,579	69.7	1,639,159	67.7
Other assets	119,925	5.1	121,418	5.0	124,879	5.3	196,871	8.4	193,129	8.0
Total assets	$2,365,882	100.0	$2,430,547	100.0	$2,339,105	100.0	$2,340,653	100.0	$2,420,883	100.0
Liabilities and Capital										
Current liabilities	$ 157,071	6.7	$ 156,745	6.4	$ 84,249	3.6	$ 98,754	4.2	$ 137,403	5.7
Bonded and debenture debt	568,728	24.0	554,828	22.8	540,706	23.1	539,582	23.1	527,035	21.8
Other liabilities	167,552	7.1	186,036	7.7	195,741	8.4	193,695	8.3	194,211	8.0
Total debt	$ 893,351	37.8	$ 897,609	36.9	$ 820,696	35.1	$ 832,031	35.6	$ 858,649	35.5
Net worth	1,472,531	62.2	1,532,938	63.1	1,518,409	64.9	1,508,622	64.4	1,562,234	64.5
Total liabilities and capital	$2,365,882	100.0	$2,430,547	100.0	$2,339,105	100.0	$2,340,653	100.0	$2,420,883	100.0
Net working capital	$ 515,224		$ 545,625		$ 485,182		$ 413,449		$ 451,192	
Book value of common stock, per share	218.82		230.70		227.84		225.92		236.46	
Balance sheet relationships:										
Current assets to current liabilities		428.0		449.0		676.0		519.0		428.0
* Fixed assets to total assets		66.5		66.1		70.3		69.7		67.7
* Total debt to total liabilities and capital		37.8		36.9		35.1		35.6		35.5
* Net worth to total liabilities and capital		62.2		63.1		64.9		64.4		64.5
Condensed income account:										
Sales	$1,448,558		$1,755,477		$ 986,750		$1,092,698		$1,571,414	
Ratio to fixed assets		92.0		109.3		60.1		67.0		95.8
Ratio to total assets		61.3		72.1		42.2		46.7		64.8
$ of sales per $1 of inventory	$ 6.38		$ 6.80		$ 4.08		$ 4.95		$ 5.80	
Average days' sales represented by accounts receivable	19		24		20		24		19	
Expenses	$1,300,886		$1,563,754		$ 939,720		$1,032,958		$1,407,097	
Ratio to sales		89.8		89.1		95.2		94.5		89.6
Profits from operations	$ 147,672		$ 191,723		$ 47,030		$ 59,740		$ 164,317	
Ratio to sales		10.2		10.9		4.8		5.5		10.5
Ratio to total capital employed		6.2		7.9		2.1		2.6		6.8
Net income	$ 76,795		$ 109,694		$ 36,617		$ 39,653		$ 108,707	
Ratio to sales		5.3		6.3		3.7		3.6		6.9
Ratio to net worth at first of year		5.3		7.5		2.4		2.6		7.2
Composite summary index (base, 100, = average for three years 1919, 1920, 1921)	100.3		108.2		89.6		84.6		104.6	

[1] The manner in which the company's assets are invested and the sources from which its capital is drawn are indicated by the percentages shown against the various balance sheet items. The ratios marked (*) consequently appear in the balance sheets; they are repeated below for emphasis.

	From Table 3 (Wall) Base 1919	*From Table 4 (Writer) Base 1919, 1920, 1921*
1919	100.0	100.3
1920	104.4	108.2
1921	100.3	89.6
1922	97.1	84.6
1923	102.1	104.6
Highest	104.4	108.2
Lowest	97.1	84.6
Range	7.3	23.6

In the writer's opinion, Table 4 is superior to Table 3, principally because commensurate importance is given in the former to operating and income elements. It is considered that from the viewpoint of the company's operating and administrative officials, the fluctuations in its business were in fact as considerable as indicated by the range of 23.6 per cent, and this view would appear to be supported by the fact that the mean of the high and low prices on the stock exchange of the company's common stock varied over the period of five years to approximately the same extent, namely 24 per cent.

As has already been stated, opinions doubtless will differ as to the suitability of the weights which have been used. It is submitted, however, that approximate weights are capable of determination, and that, this being accomplished, the use of the resultant composite index as in Table 5 is desirable.

Table 5 presents an analysis of the financial statements under consideration, in a form thought to be the most practical for general industrial purposes. In general, this presentation is of the sort advocated by Bliss, though the composite index (taken from Table 4) is an additional feature.

The opinion that the analysis presented in Table 5 is the most practical for industrial purposes is based upon the fact that the ratios shown bear obvious relation to the underlying data, hence are not difficult to comprehend; that the ratios may be compared easily from year to year without being more vaguely expressed through the use of index numbers; that the ratios may be compared with those of other companies; that the principal value of the statistical methods represented by Tables 3 and 4 is conserved by the use of the composite index.

The subject of analysis of financial statements is admittedly one which will require much further study before wholly satisfactory standards therefor may be established. These comments and suggestions are put forth not as dogma, but by way of continuing the discussion of a subject of current importance and interest.

Suggestions on Unemployment Insurance

By L. L. STENDER

ANY plan of unemployment insurance will meet with some objections, but a scheme most likely to be acceptable to the largest number will be one combining the features of greatest possible simplicity and universality. With this thought in mind, the following suggestions are offered:

1. Above all else, the scheme should be governmentally administered: By the Federal Government for those employees of industries subject to Interstate Commerce Commission regulations; by the several states for all others.
2. The scheme should cover all employees and except none.
3. The Federal Government and the several states should each enact a law providing for the appointment of a commission to administer an unemployment compensation fund.
4. The fund should be contributed by the employer only, to save clerical work, and because the money contributed must in any event come through the hands of the employer. By making the plan universal, the burden would be absorbed equitably by consumers.
5. Wage earners should be classified by industries and the premium rates made to conform in proportion to the hazard (losses) of each class.
6. There should be a maximum and a minimum rate for each class, with a modification of the Merrit rating plans as now used for the operation of some state workmen's compensation laws.
7. The premium rate should be adequate to build up a reserve against possible heavy demands on the fund.
8. Premium rates to classes should conform to the average wage of the employees, and the probable payments from the fund for the class.
9. The amount of compensation paid to a claimant should be (possibly) only 50 per cent of his average earnings for a reasonable period immediately preceding the date when idleness began (say three to six months).
10. No compensation should be paid for a short period of idleness. The minimum should not be less than one week, possibly two.
11. After payments have begun, they should continue until employment is secured.
12. Some consideration should be given to the kind of employment a wage earner would be expected to accept.
13. The minimum and maximum amounts of compensation provided should be proportioned to the number of dependents of the claimant.
14. The fund should pay its own administrative costs.
15. The machinery for establishing justness of claims against the fund would be similar to that now in use by various state workmen's compensation departments.
16. There should be an institution to act as an employment exchange for claimants.

A discussion here of the more technical problems, such as actuarial work in connection with premium rates, what would constitute a just claim, etc., would tend only to detract from a consideration of the main question. It will be found, however, that if there is a real need and a concerted demand for unemployment insurance, answers to all questions will be found.

Lumber Handling Simplified

Equipment That Will Save Labor and Money

By THOMAS D. PERRY

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Formerly Manager, Grand Rapids Vapor Kiln Company

THE old-fashioned lumber yard, with its enormous piles of lumber, will ere long become as much a matter of historic interest as the ordinary bicycle or the horse-drawn delivery wagon. Many reasons make up the total cause—the high cost of labor in handling, the greater deterioration losses as lumber values increase, the demand of engineers for more rapid turnover of working capital, and the development of kilns that will satisfactorily dry green lumber whenever necessary.

Progressive woodworkers are converting their old-fashioned lumber-piled yards to a "track and truck" basis, laying out trackage to match the kiln rails and piling lumber direct from the railroad car, or receiving truck, onto kiln trucks. The kiln carloads, so piled, can be shunted or shifted to classified sections arranged according to varieties, thicknesses, lengths or grades. From such a classified stock it is easy to quickly assemble a kiln charge of just the items needed. These green storage tracks are preferably set in concrete and accessibly arranged with frequent transfer tracks.

FIG. 1 STORAGE YARD AND 16 GRAND RAPIDS VAPOR KILNS AT BERKEY & GAY FURNITURE COMPANY

After kiln drying, dry storage rooms should be provided to enable a similar classified arrangement of kiln dried stock, still on wheels. Dry storage should be adequate to allow a week of tempering (cooling or equalizing) and a sufficient reserve of dry stock to protect production against kiln delays or shut-downs.

Fig. 1 shows the lumber yard, kilns and dry storage room of the Berkey and Gay Manufacturing Company's furniture factory. Half of a large city block (175 by 550 ft.) is devoted to the lumber and dimensioning department. The railroad siding runs through the alley, serving both yard and factory, box cars being visible in the left front. The manufacturing buildings, approximately as large as the yard, are to the left and not shown. At the right are 16 tracks, traversed by 2 transfer alleys, each track holding 24 kiln cars of lumber or about 80,000 ft. In the center can be seen 16 box kilns, opening in batteries of 4 on the 2 transfers. Beyond the kilns is a two-story structure containing dry storage and cut up department below and employees' assembly room above. The yard will carry over 1,000,000 ft. of lumber. The kilns, holding 100 kiln cars, will dry daily about 30,000 ft. (2 railroad cars) of average furniture lumber.

Of course, not every concern uses this much lumber in its daily operations, and, on first thought, a system of storing and handling such as that employed by the Berkey and Gay Company may not appear economical for any but lumber companies and furniture and box manufacturers. But there are a great many plants requiring lumber in large quantities either directly in manufacturing, or for patterns, foundry flasks, barrels, boxes, crates, and similar purposes. Manual labor, or unsystematic methods of handling, or a combination of both, means money thrown away when wood is handled, just as much as when iron, steel, package goods, or other industrial materials and products are involved. As soon as any woodworking department reaches the point in its activities where operations take on the character of regular production, then the introduction of methods to control this production, and material-handling equipment to eliminate useless work, reduce costs and prevent waste.

Power lifts and auto pushers greatly facilitate loading and unloading kiln cars and shifting them around the yard and kilns as shown in the following pages.

Lumber Lifts. Kiln cars of lumber are usually about 10 ft. high, and it has been an awkward and laborious process to unload them down to the sawyer, board by board or pile them down on lumber buggies that could be pushed up to the saw table. Fig. 2 shows this hand operation in progress. The car has just been run into the wood-working department and 2 men are engaged in removing the lumber, a waste of at least one man's time, and, where the sawyer is the second man, an interruption of his work with a consequent lowering of production. Decreased output means a higher direct cost per foot, and, not only that, but also a greater indirect charge, for the saw is idle, the space is occupied for a longer time by a given quantity of lumber, the capital turnover is lowered, and probably a machine or two more than is necessary may be in operation. When all these losses are totaled they form a large percentage of the cost of running a wood-working industry or department.

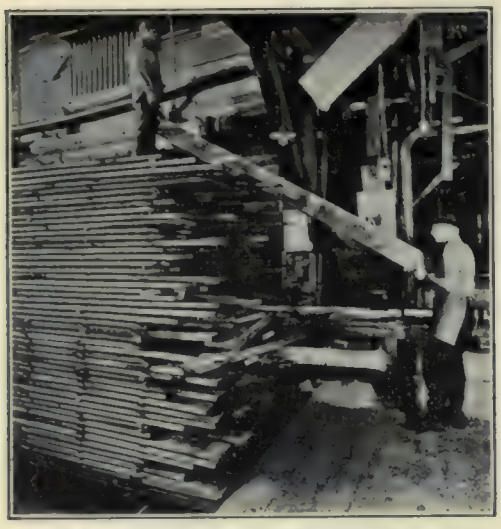


FIG. 2 UNECONOMICAL HANDLING METHOD

Fortunately they are preventable, and at a reasonable expense. Hence, the mechanical equipment involved is profitably within the reach of most shops where lumber is used on a production basis in manufacturing, or in making equipment, shipping containers, etc. A lumber lift can be installed to handle the kiln cars, and will occupy no more space than the car itself requires, except, of course, for a pit in the floor below. Since sawing operations are usually performed on the ground floor of a plant, and the basement, if any exists, is rarely used for purposes which make the underground space of much value, a pit can usually be put in without inconvenience and at a low cost.

The lumber lift illustrated in Figs. 3 and 4 consists of 4 vertical, revolving but non-elevating screws, carrying a platform that is raised and lowered by non-revolving nuts at each of the 4 corners. The 4 screws are operated simultaneously by electric motor, through silent chain drive and bevel gears. The lift platform travels 8 or 10 feet vertically and has rails to match the kiln or transfer trackage.

A kiln car of dried lumber is placed on the lift platform and lowered to a point where the top boards are easily slid off onto the saw table by the sawyer. This position of the lift is shown in the center illustration, Fig. 3. When 2 or more layers of boards have been removed and run through the machine, the operator pushes a convenient button control switch and raises the pile of lumber a few inches until the top boards are again a little above the level of his table. When the next 2 or 3 layers of lumber have been put through the saw he repeats the process, and by this method the successive courses of boards are sawed.

The lower illustration, Fig. 4, shows the last few courses of lumber raised to a convenient point as the lift approaches its top position. The stickers, holding boards apart, are pushed aside into a basket or hopper as each layer is removed, and require no more handling than without the lift.

The use of a lumber lift in unloading eliminates the unloading man entirely and enables the sawyer to cut from 25 to 33 per cent more lumber per day, since every board is delivered to him at a convenient working height. The cost of a lift installation, exclusive of cement pit, will approximate $2000 for average sizes and ranges. In other words, it will pay for itself in about a year by the elimination of the sawyer's helper and the increased output, and will produce a corresponding profit thereafter during its operation.

The lifts can be built for elevators up to 20 ft., and are often adapted to conveying loaded kiln cars from floor to floor.

FIG. 3 COMMENCING TO UNLOAD FROM LUMBER LIFT

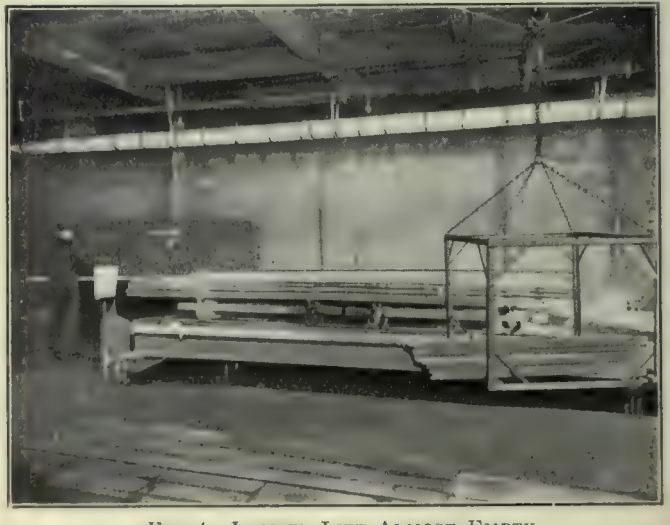


FIG. 4 LUMBER LIFT ALMOST EMPTY

Power Transfers. Six or eight men make a rather hard job of pushing a kiln car of lumber, which is usually 6 ft. wide by 16 ft. long and often 10 to 12 ft.

FIG. 5 PUSHING A TRANSFER CAR IS COSTLY AND UNPOPULAR

high above the ground. (See Fig. 5.) The diameter of kiln truck and transfer car wheels must be kept at a minimum to avoid wasting too much room in the kilns or too deep transfer depressions in the yard. Rails must be level unless the lumber always moves in one direction. In this case a slight slope from storage to shop will help the handling operations, although it may be undesirable from other standpoints.

Only large lumber yards have enough kiln car forwarding to keep a gang continuously busy and it is "man-killing" work, that most certainly should be done by power. Small and medium-sized yards have to stop other work to bring their crews to this task, and it is a most unpopular assignment. There is little or no defense for the policy of interrupting the production of any department or shutting down machines to assemble a kiln car forwarding crew.

If the quantity of lumber handled is sufficient to justify transfer cars they should by all means be mechanically operated. Various methods are available, any one of which well repays its investment price. The type of equipment to choose depends on the individual case. Electric motors with flexible electric cord, or driven from overhead or underneath trolley wires, or by storage batteries, can be mounted on the cars. Gasoline engines have also been successfully applied.

Where electric power is available it can often be most readily utilized. However, the flexible cord method may be a nuisance. A trolley line is dangerous to both life and property on account of the bare wires. Storage batteries may be unduly expensive on account of the nature of the service. The gasoline engine is very often employed because it has a wide range of operation and safely withstands overloads. Where the maximum travel is only 100 to 200 ft., however, electric motor drive is most frequently employed.

In Figs. 6 and 7 a power-driven transfer car is illustrated. Fig. 6 shows the car removing a truck from the kiln. The flexible wire rope and hook, reeved over rollers and pulleys, used on this power transfer for drawing loads on and off, is explained fully in the description of the motor transfer car which follows on the next page. Only one man is required for this work and he operates the loading mechanism from a platform at one end of the transfer car.

When the load has been taken on, the operator throws in the lever and runs the transfer car along the track to the dry storage rooms, where a reserve of kiln dried lumber is kept. The dry storage rooms also give adequate opportunity (3 to 6 days) for the lumber to cool and reach normal moisture content. From the dry storage rooms the kiln car, when needed, is again drawn onto a power transfer and conveyed to the sawyer where, in the best equipped shops, it is delivered on the rails of a lumber lift. Fig. 7 shows a power-driven transfer car carrying a load of lumber to the kilns. Space otherwise necessary for end clearance is conserved by locating the operator's platform on the side instead of on the end of the car.

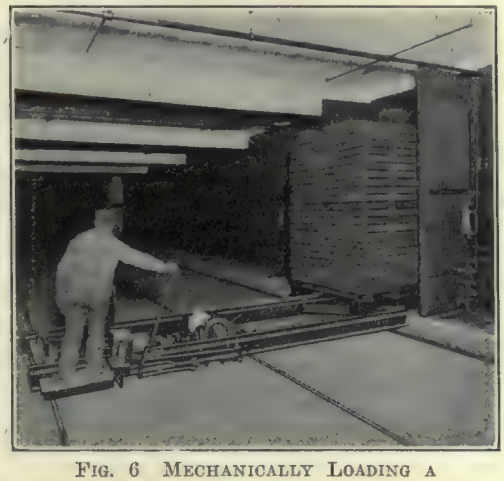


FIG. 6 MECHANICALLY LOADING A TRANSFER CAR

The power transfer unit illustrated here costs approximately $2500, depending on local conditions. If it reduces a yard crew from 6 to 2 men, it will result in the saving of 4 men's wages, or about $4000 to $4500 annually, based on continuous service. This amount is a return of 60 to 80 per cent on the investment. If used half the time, it would save its cost in a year and eliminate much confusion and interruption of production work.

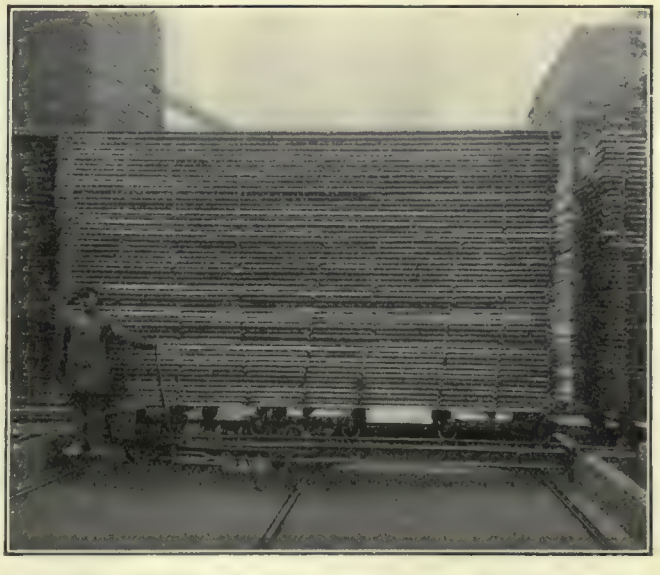


FIG. 7 MOVING THE TRANSFER CAR BY POWER

Motor Transfer Car. There are many locations where the previously described power transfer is too large or expensive, and hence something else must be employed. To answer the need, what is known as the motor transfer car has been developed. This unit, illustrated in Figs. 9 and 10, contains self-propelling and wire-rope-towing equipment similar to that on the power transfer in Figs. 6 and 7, but condensed into much less space and carried on a separate little car rigidly coupled to the regular transfer car. The motor transfer car type of equipment is more particularly adapted to narrow gage rails than the power transfer type is, and therefore is suitable for cross-pile kiln installations, where lumber lies at right angles to the rails in the kiln. The cross-pile way of stacking lumber is shown in the accompanying pictures.

FIG. 8 WASTING THE LABOR OF SEVEN MEN

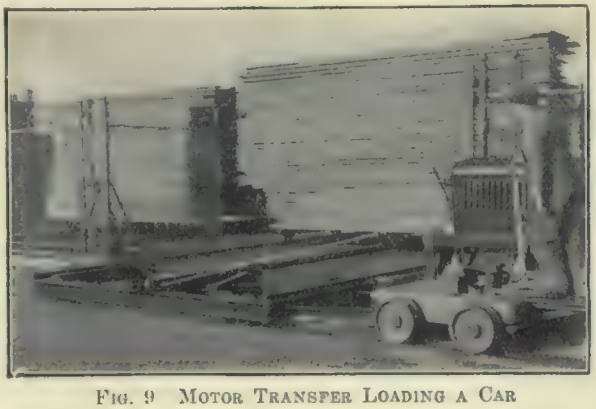


FIG. 9 MOTOR TRANSFER LOADING A CAR

The flexible wire rope, hook and drum for drawing kiln loads on and off transfer cars has an operating range of 150 ft. from the center of the transfer car. The wire rope drum is hung under the base casting and can be revolved in either direction to draw on loads or pay out the wire rope when unloading.

The power unit, operated by gasoline or electricity, is connected by clutch and reversible gearing to the wheels on the truck, and, by means of a shift lever, to the wire rope drum. Duplex foot brakes provide for holding the transfer car in position while loads are being drawn on or off, and also for keeping wire rope taut and holding the load in position while the transfer is traveling.

Fig. 8 shows the reason why the purchase of such a piece of equipment is economical. From 6 to 8 men are required to push a loaded car down the track to the kilns and also to remove it after the lumber has been dried. Of course, the one gang can bring up a car of green lumber, remove a load of dried lumber from the kiln, and put the new charge in. But even when the two jobs are combined there is no reason why the time and labor of any but one, or at the most two, of these men should be necessary.

Even in the small plant, where only a few kilns are run and the moving of lumber is not a continuous operation, a motor transfer car can be profitably employed. Instead of assembling a gang for the work, a yard foreman or a lumber inspector can act as "chauffeur" for the car.

This transfer motor can be detached from the car, which cannot run over curves or switches, and the motor then switched to other transfer tracks. Another function filled by the transfer motor is to operate turntables, where the direction of travel is to be changed, and a few properly located "snubbing posts" will give suitable anchorages for hooks. Drawing up the wire rope will revolve the turntable as desired.

The motor transfer car is much to be preferred over any type of standard tractor, with or without flanged wheels. The average tractor has no drum attachment, is built too high to couple to a transfer car, and is not flexible enough in starting, stopping and reversing to permit easy matching of rails.

The motor transfer car costs approximately $1500 and will pay for itself in a year by saving 4 or more men, even if operated only one-third of the time.

The present article has contrasted briefly only a few operations where the old methods of handling lumber have been simplified by the new, and costs have been lowered by the system of storing on wheels, and by the use of mechanical handling equipment to move material to and through kiln drying and sawing processes. Many more opportunities exist to save money in handling material in the wood-working industries, at little expense for improvements.

FIG. 10 MOTOR TRANSFER HANDLING A KILN CAR

Simple Methods of Reducing Damage to Shipments

By W. H. UPSON Jr.

Treasurer, The Upson Company

STANDING on a freight platform out in Iowa I was watching a laborer unload Upson board from a car on to his truck. The long bundles were transferred in a most hit-or-miss fashion. The man in the car wrestled with a 4 by 16 ft. panel, scraping the edges and swearing at ill-offered advice; finally he dropped the board—a few more dollars for the junk pile.

There I discovered the chief reason why the traffic department of our organization received so many complaints referring to damaged goods. Now Upson wall board is not exactly fragile, and it is packed with every possible care. But in spite of this, damage obligations were too numerous, and after seeing a few unloaders in action at many different freight yards, it did not take me long to appreciate that the solution of the problem lay in our breaking the customer of the breakage habit.

If you are going to educate the other fellow the first thing to do is to educate yourself; be sure of the facts. So we sent investigators around the country with Kodaks to photograph the erring laborers in action. You see they wouldn't quite believe me in the traffic department, so I had to have some horrible examples to prove my point.

Of course, the investigation was an eye-opener; the pictures most illuminating; the necessity for handing the dealers a primary education in the handling of Upson board most painfully evident. So now for the cure! Just as we utilized the photographs to show the errors, so likewise we utilized visual education to show the corrections.

Results of Our Investigation

Our investigation showed that frequently as many as four men were used to unload a car of ordinary wall board panels; rarely were less than three men used. This procedure took two men at one end of the panel and from one to two at the other end. By this method the boards were carried flat and, of course, sagged heavily in the middle. We now actually proved that when the panels are properly moved, that is, edgewise, only two men are required, and they handle the load with much less fuss and greater ease. In other words, the proper method saves from $25 to $50 a car.

In referring to the correct method of unloading single long panels rather than bundles of panels from the car, we illustrated both the correct and the incorrect methods of handling. Here again investigation and trial tests proved that the right way required only two men. We also found it important to stress the correct position for the hand truck if such is used in place of a wagon or automobile. We found and demonstrated that the handiest position for the hand truck is at right angles to the car door. The maximum of efficiency was also attained by placing stringers across the top of the truck platform to prevent the panels from sagging. Likewise a rope attached to the handle of the truck helped one to guide it with greater facility.

Meticulous observations, perhaps, but time and study have proved these little points valuable suggestions. After all, why shouldn't one just as carefully study the difficulties of his customers as he does the production problems of his own plant?

Some Practical Suggestions

Further observations led us to appreciate that even after precaution in unloading, serious damage frequently occurred during truckage from car to the lumber yard. We soon discovered that this was due almost entirely to the lack of care in providing the lumber wagon or truck with a proper platform. So we suggested that a cheap platform should be built up in order to have the bundles clear both wheels and bolsters. This also brings the wagon to approximately the freight car level and gives a good safe platform for the men to work upon.

From this point naturally followed instructions on how to unload bundles or panels from wagon to shed. As in the previous case, we studied the question with great care. The result is that our illustrated booklet and copy strongly advocate sliding the panels off the wagon with the flat side down. Previously, many of our customers were unloading the panels edgeways. The consequent scraping of the edge caused many complaints from the dealers' customers, who, seeing the frayed edges and broken corners, thought they were getting "seconds."

Also, we found out that the dealers were placing the wagon so that it faced the door of the shed lengthwise. As is true with the hand truck, so with the wagon—the proper way to face the shed door, or freight car door for that matter, is with the wagon at right angles to the door. With the truck incorrectly placed, the panels were twisted when pulled off the load. This twisting frequently left its mark—almost a crack down the center of the flexible board.

The final problem was in the matter of storage. This required a more elaborate process of education and one in which we prepared blue-prints for the dealers, showing them how to build a proper board rack. Our copy on this subject advocates the neces-

sity of having a clean, dry shed or building with bins or shelves parallel to the floor, so that the panels can be easily and quickly removed with a minimum of labor. We strongly emphasize the necessity of cleanliness. Nothing so readily prevents a sale as dirty merchandise.

The solution of these problems carried us a long way. Our educational booklets made a great hit, and helped to augment the friendship between ourselves and our selling associates. But there was yet another difficulty to be overcome. We found that oftentimes the contents of a car are transferred en route. Damage from such transfer is almost inevitable as the result of rough handling so often given by the railroad.

The next step then was education of the railroads of the country. It was encouraging to note how readily they welcomed our suggestions. Indeed, before long our dealers' booklets were requested by every transportation company, and in many cases we have supplied all the freight agents with our instructions, originally published for lumber merchants only. In spite of this, however, and the fact that agents have been cautioned by the higher authorities to study our booklets, carefully, some railroad damage still occurs. So again we are required to give the dealers a few pointers concerning the necessity of their inspecting cars before unloading, and of immediately reporting any damage or discrepancy to their local agent. We also warn them to have the agent note on the paid freight bill any discrepancy or damage, so that their claim may be properly filed.

We further emphasize the fact that inspection of car seals is important. If inspection shows car seals to be intact, yet upon opening the doors, contents are found damaged in any way, we urge the dealer to have his freight agent inspect the car immediately so that he may make the proper notation of damage. We point out that if the car contents are damaged, it is evident that the car was handled roughly in transit. We show that every car is properly inspected before it leaves our yard at Lockport, and, therefore, there is no liability on our part for damage in transit.

But we don't leave it there—not by any means. When the dealer has followed all these precautions, our next step is to assure him of our continued interest, and with this goes the offer to collect his claim for him. Doing this is sometimes onerous, and has required a special department at our home office. But the profit derived from good-will has more than offset the extra expense.

To everlastingly remind the dealer of the above and the necessary procedure to be followed for obtaining reimbursement, we always attach a printed slip to the customer's copy of the bill of lading. The slip, as shown in Fig. 1, completely covers the necessary instructions, together with other suggestions which at the very outset establish certain rules both of us must follow if the Profit and Loss account at the end of the year is to show up on the right side of the ledger.

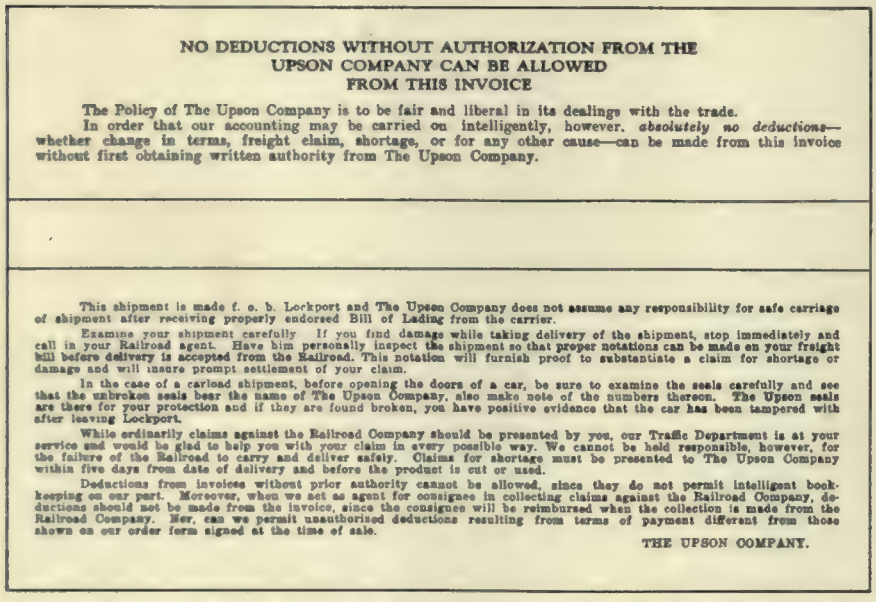
Our traffic department has another stunt which coins good-will by the barrelful—and that is the Freight Auditing Bureau, which functions as a branch of this department. This is a free service to all dealers, and is explained through the medium of another little slip, a pink one, which is also attached to the bill of lading. This slip briefly tells about the service as follows:

SEND YOUR FREIGHT BILL FOR AUDIT!

During the year of 1919 approximately 3 per cent of all the money paid for transportation was paid back to the shipper and receivers of freight in the form of claims. *This represents only part of the money that could have been collected.* Auditing your freight bills is simply a part of the Upson Service. It costs you nothing. Just send in your *paid freight bills*—perhaps we can find money for you.

When the customer receives a check from us representing our collection from the railroad for incorrect overcharges—and the railroad errors are so abundant that many auditing concerns do this type of work on a 50-50 basis and grow rich—he is won for life. To him it is just like picking up money on the street. This offer doesn't refer to just those freight bills which pertain to purchased Upson products, for we audit all of the dealer's bills covering any merchandise whatsoever!

We are absolutely sold on service. For we are thoroughly convinced that a sale is not complete until the goods are properly and securely delivered, not only to the door of our dealer, but right up to the gate of *his* customers. In the final analysis, it is always our reputation which is at stake. So these ideas have justified themselves and have proved to be real business builders. Good-will is a vital part of any business, yet it is one of the hardest to secure and maintain. Our definite plan of assistance to our customers has greatly increased their loyalty to us and to our products, to the mutual benefit of all.



NO DEDUCTIONS WITHOUT AUTHORIZATION FROM THE UPSON COMPANY CAN BE ALLOWED FROM THIS INVOICE

The Policy of The Upson Company is to be fair and liberal in its dealings with the trade.

In order that our accounting may be carried on intelligently, however, *absolutely no deductions*—whether change in terms, freight claim, shortage, or for any other cause—can be made from this invoice without first obtaining written authority from The Upson Company.

This shipment is made f. o. b. Lockport and The Upson Company does not assume any responsibility for safe carriage of shipment after receiving properly endorsed Bill of Lading from the carrier.

Examine your shipment carefully If you find damage while taking delivery of the shipment, stop immediately and call in your Railroad agent. Have him personally inspect the shipment so that proper notations can be made on your freight bill before delivery is accepted from the Railroad. This notation will furnish proof to substantiate a claim for shortage or damage and will insure prompt settlement of your claim.

In the case of a carload shipment, before opening the doors of a car, be sure to examine the seals carefully and see that the unbroken seals bear the name of The Upson Company, also make note of the numbers thereon. The Upson seals are there for your protection and if they are found broken, you have positive evidence that the car has been tampered with after leaving Lockport.

While ordinarily claims against the Railroad Company should be presented by you, our Traffic Department is at your service and would be glad to help you with your claim in every possible way. We cannot be held responsible, however, for the failure of the Railroad to carry and deliver safely. Claims for shortage must be presented to The Upson Company within five days from date of delivery and before the product is cut or used.

Deductions from invoices without prior authority cannot be allowed, since they do not permit intelligent bookkeeping on our part. Moreover, when we act as agent for consignee in collecting claims against the Railroad Company, deductions should not be made from the invoice, since the consignee will be reimbursed when the collection is made from the Railroad Company. Nor, can we permit unauthorized deductions resulting from terms of payment different from those shown on our order form signed at the time of sale.

THE UPSON COMPANY.

FIG. 1 PRINTED SLIP ATTACHED TO CUSTOMER'S COPY OF BILL OF LADING

Beech-Nut Purchasing System Controls All Material and Supplies

By JOHN GORE

Management Engineer, Beech-Nut Packing Company

THE efficient control of purchases, that is, having on hand at all times the correct quantity of material, is one of the most important problems that the purchasing agent has to solve and it is usually one of the most difficult. This is true in any manufacturing concern, but is especially so where a wide variety of products is manufactured by the same company. If, in addition to this, the finished products happen to be perishable and the raw materials have to be bought anywhere from one to five months in advance, then, indeed, the problem is exceedingly complicated. Such is the case with the Beech-Nut Packing Company, which manufactures a wide variety of perishable products, differing not only in their method of manufacture, but in the materials used in their making.

The principal factor with which we have to contend in purchase control is, perhaps, the relatively large number of entirely different items which must be purchased. This is, to a large extent, due to the fact that in addition to making a variety of products, we also manufacture various sizes and flavors. For example, 49 different materials are used in making mints, 37 in fruit drops, 36 in gum and 67 in meat. These are all strictly raw materials or materials used in packing and most of them are vitally essential. In a few instances the same material is used in making two or more products, but this is true in the case of only about ten items.

Another controlling factor in our business is the fact that the majority of our products are perishable. It is true that many of them will keep almost indefinitely, but nevertheless we believe that any food product is never better than upon the day it is packed. For this reason we aim to keep our stock of finished products at a minimum, and our merchandising plans are all based on getting these products to the consumer with as little delay as possible.

A third factor with which we have to contend in purchasing is the fact that we use so much lithographed material. All such material has to be ordered from four to five months in advance and as all of our labels and wrappers, and most of our boxes, are lithographed, the quantity which has to be ordered far ahead is a pretty big item. In addition, many other materials, such as paper, glass, shooks, etc., must be ordered considerably in advance of the time they are to be used.

A fourth factor which has to be considered in purchase control is that our sales vary considerably at different times during the year. Some products vary as much as 1200 per cent; that is, at certain periods of the year, due to seasonal variation, our sales are 12 times what they are at other periods. This fortunately is not the case with most of our products, although they all vary at least as much as 200 per cent.

Considering the above factors it can be readily seen that always to have on hand sufficient material and yet not have too much at any one time is, with us, a real problem. If more material is bought and received than can be used, not only is considerable money tied up, which is costly, but there is difficulty experienced in storing the excess material. In addition, some of our raw materials are perishable and, if ordered in excess of production, are likely to spoil. On the other hand, if materials are not ordered sufficiently in advance, production will be held up and, since many of our orders are for a variety of products, if our stock is low on even one of these, many orders are likely to be held up.

In order to control efficiently the purchase of materials under these conditions, some sort of mechanism is a necessity. Our system was developed to fill a long felt want and has now been in operation for some time. As it has worked out so well, although still open to improvement, and, as it seems to be so adaptable to other businesses, it is given here in the hope that it will be of value to others.

Sales Estimate

The actual control of purchases is clearly based on a co-ordination of sales, production, and purchases, and the first step in such control evidently is to make a sales estimate. All other schedules or estimates are dependent upon this, and it is absolutely vital that the sales estimate should have the most accurate basis possible. In some businesses it might be possible to have a sales schedule or sales budget which would be based on sales quotas and which could be used as a basis for the sales estimate. In any case, the sales estimate should have the following basis:

1. A knowledge of past sales for three or four years at least.
2. A knowledge of the plans and policies of the business, particularly as regards sales and advertising campaigns.
3. A knowledge of general business and trade conditions.

In other words, the sales estimate should be an estimate of future sales based on past experience, modified by future plans and still further modified by existing business conditions.

MINTS RECORD SHEET

WEEK ENDING	SHIPMENTS																ACTUAL PRODUCTION							STOCK ON HAND						
	PEPPERMINT			CLOVE			WINTERGREEN			CINNAMON			SPEARMINT			TOTAL				Pep-per-mint	Clove	Win-ter-green	Cin-na-mon	Spear-mint	Total						
1924	Wkly.	3 Wkly. Ave.	%	Wkly.	3 Wkly. Ave.	%	Wkly.	3 Wkly. Ave.	%	Wkly.	3 Wkly. Ave.	%	Wkly.	3 Wkly. Ave.	%	Wkly.	3 Wkly. Ave.	Cum.							Wkly. Bal.	Cum. 100,000					
																									25,202	40,214	15,010	5,000	14,574	100,000
Jan. 5	50,212	48,100	31.3	40,168	41,172	26.7	39,665	36,545	25.0	15,576	15,598	10.2	10,142	10,446	6.8	155,763	153,811	155,763	90,000	40,000	40,000	20,000	10,000	160,000	260,000	25,000	40,046	17,046	7,723	14,432	104,247
" 12	49,176	51,165	31.7	43,241	41,504	25.8	40,047	40,315	25.0	16,132	16,239	10.1	11,279	11,862	7.4	159,875	161,085	315,638	60,000	50,000	35,000	20,000	15,000	180,000	440,000	35,824	46,805	15,000	8,590	18,153	124,372
" 19	54,107			41,102			41,234			17,010			14,166			167,619		483,257	40,000	50,000	45,000	15,000	10,000	160,000	600,000	21,717	55,703	16,300	9,046	13,987	116,753
" 26																															
Feb. 2																															
" 9																															
" 16																															

FIG. 1 RECORD SHEET FROM WHICH IS OBTAINED DATA

The second step is the making of a production estimate. The sales estimate should be the principal basis for the production estimate, but this cannot be used blindly. There are certain production factors which must be considered and, of these, the following are perhaps the most important:

1. Stock on hand at the beginning of the estimate period.
2. Stock on hand desired for the end of the period.
3. Co-ordination with other departments so as to have balanced production throughout the factory.

The first two factors are, to a large extent, based on the keeping quality of the finished product; and this, as previously explained, is an important consideration with us. It is our aim always to keep our stocks at a minimum and for this reason, and the fact that our sales are constantly varying, we have not, as yet, been able to make a real production schedule that is effective very far ahead. Hence we make only a production *estimate*. Where possible, however, it is advised that a production *schedule* be made and used in place of the estimate.

As to the relation between the sales estimate and the production estimate, where a real production schedule can be made and followed fairly closely, it will probably be found advisable to keep the sales estimate distinct from the production schedule, and use the former as a basis for the latter. With us, however, due to the fact that our production estimate so nearly approaches our sales estimate, it has been found best to make but one—the production estimate. In arriving at this, we make a production estimate which is primarily based on estimated sales, but which has been modified by considering (1) future plans, (2) business conditions, and (3) the extent to which it is desired to stock up the finished product.

In connection with the actual making of the estimates, we have a series of record sheets (Fig. 1), which

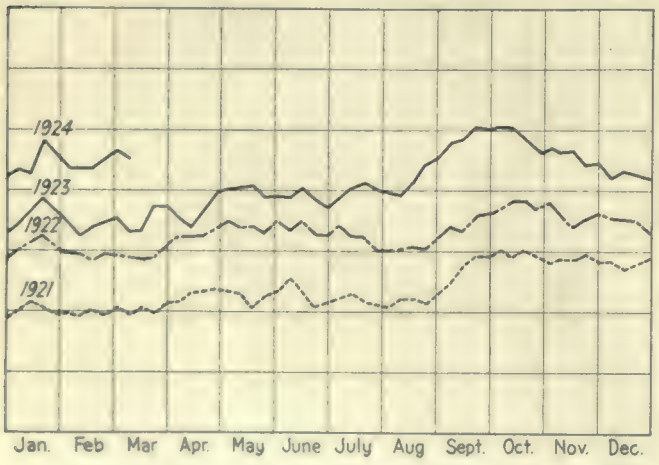


FIG. 2 TOTAL SHIPMENTS GRAPH, PLOTTED ON A 3-WEEKLY AVERAGE BASIS

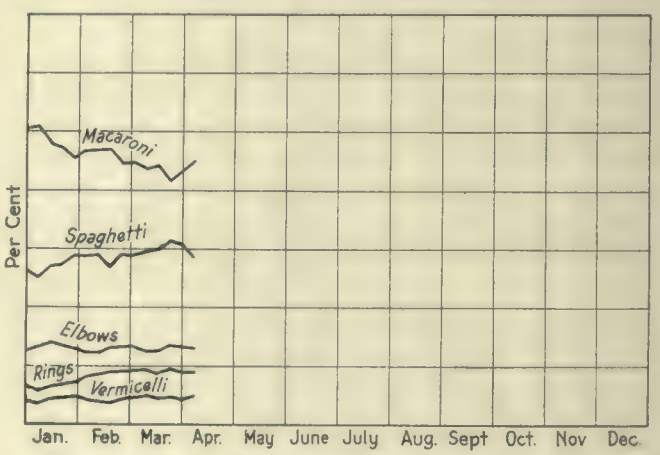


FIG. 3 FLAVOR PERCENTAGE GRAPH

serve also as work sheets, and from which we get the figures for the following graphic charts:

1. *Total shipments* (Fig. 2), plotted on a three-weekly average basis in order to smooth out the curves somewhat and eliminate the effect of carload shipments.
2. *Flavor percentages* (Fig. 3), plotted also on a three-weekly average basis.
3. *Cumulative curves* (Fig. 4) of total shipments and total production.

From a consideration of these charts and other factors, a production estimate is made for a period of seven weeks. We always estimate a group of products as a whole regardless of flavors. Having done this, we calculate by the use of the record sheets the estimated production for each flavor. In doing this we take into account the present stock on hand and assume that the stock of each flavor will be of the same relative magnitude at the end of the period. We also use per cent

BEECH-NUT PACKING COMPANY
Canajoharie, N. Y.

TOTAL EST'D PROD. FOR NEXT 7 WKS.	TOTAL EST'D PROD. Next 7 Wks. Plus Total Stk. on Hand	ESTIMATED PRODUCTION																						WEEK ENDING
		PEPPERMINT					CLOVE					WINTERGREEN					CINNAMON					SPEARMINT					
		%	Est'd. Prod Plus Stock	Stock	Est'd Prod. 7 Wks.	Est'd Prod. Wkly Ave.	%	Est'd. Prod Plus Stock	Stock	Est'd Prod. 7 Wks	Est'd Prod. Wkly Ave.	%	Est'd. Prod. Plus Stock	Stock	Est'd Prod. 7 Wks.	Est'd Prod. Wkly Ave.	%	Est'd. Prod Plus Stock	Stock	Est'd Prod 7 Wks.	Est'd Prod Wkly Ave.	%	Est'd. Prod Plus Stock	Stock	Est'd Prod. 7 Wks.	Est'd Prod. Wkly. Ave.	1924
1,155,000	1,259,247	31.6	317,000	25,000	372,000	53,200	26.5	334,000	40,046	294,000	42,000	25.0	314,000	17,046	297,000	42,400	10.0	126,000	7,723	118,300	16,900	7.0	88,000	14432	73,600	10,500	Jan. 5
																											" 12
1,300,000	1,416,753	31.5	490000	21717	424300	60600	26.0	368,000	55,703	312,300	44,700	25.2	357,000	16,300	340,700	48,700	10.2	145000	9,046	136,000	19,500	7.1	101,000	13,987	87,000	12,500	" 19
																											" 26
																											Feb. 2
																											" 9
																											" 16

FOR GRAPHIC CHARTS SHOWN IN FIGS. 2, 3, AND 4

figures which are estimated from the per cent charts and which are revised as often as necessary.

All estimates cover a period of seven weeks, and a new estimate is made out every two or three weeks for most products. In a few instances, however, the

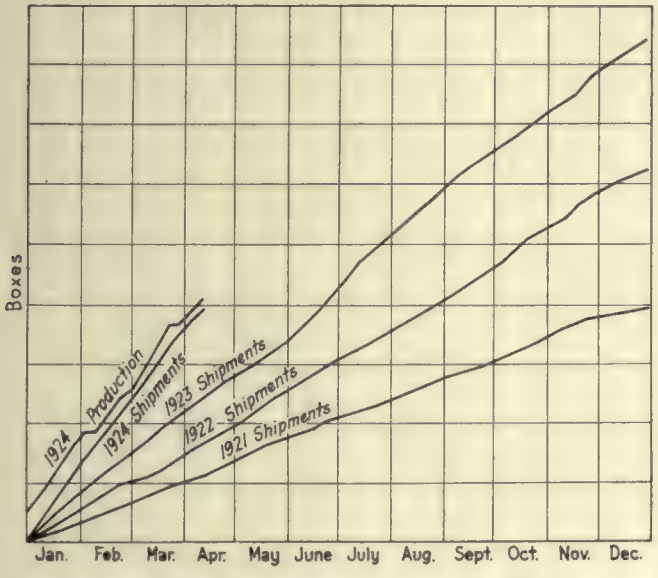


FIG. 4 CUMULATIVE CURVES OF TOTAL PRODUCTION AND TOTAL SHIPMENTS

schedules are calculated monthly, as that seems to be sufficient. The production estimate is made for a definite period of seven weeks although any number of weeks can be used. In any case, a figure should be taken which is somewhere in the neighborhood of the average minimum ordering time.

Estimates are not made in the usual budget manner, which consists of calculating ahead by periods—each period being added to the previous one in a cumulative manner. The regular budget method enables an easier comparison of the actual with the estimated but is believed to be less flexible and less accurate than the method we use.

In addition to the seven-weeks estimate, we also make a 20-weeks estimate for many of the products. This 20-weeks estimate is made to be used only in the case of lithographed materials and then only to correct the figure obtained by using the seven-weeks estimate.

After the production estimate, the next step is to make a material schedule. This is calculated from the production estimate by the use of conversion factors and conversion sheets (Fig. 5). The conversion factors are obtained from the accounting and stores records and represent the quantity of each material needed in order to produce one unit of production. The factors are calculated monthly, and the figures used in the conversion sheets are revised when necessary. In the case of some materials the conversion factors vary considerably from month to month; in others they are very constant. The figures used should be liberal; that is, it seems best to us to be somewhat on the safe side and have too much material rather than too little.

Although the majority of our material requirements can be calculated from conversion factors, there are a few materials which cannot be calculated in this manner. The majority of these are used for products such as samples, etc., for which no production estimate can be satisfactorily made. In such cases cumulative curves (Fig. 6) are made and used as a basis for the material schedule. These curves show the usage for the current year compared with that for the past two or three years.

Occasionally we compare the material estimated with the material actually used. To check this up each month would require much work and it is doubtful if it would pay to do that. On the other hand, for a number of reasons, it seems advisable to do this occasionally.

Purchase Schedule

After calculating the figures for the material schedule the next step is to make out what we call a purchase schedule (Fig. 7). This is not, technically speaking, a real schedule of purchases, but is called that for want of a better name.

The material schedule, as calculated from the production estimate and conversion factors, is put on the sheet along with the quantity of material on hand, on order, and on contract. From these figures is calculated the number of weeks that this stock will last. (Except in ordering miscellaneous supplies for our miscellaneous stores, the minimum and maximum stock ordering method was found to be useless. The fact that we have on hand 10,000 lb. of foil would not mean much to us, as our sales and production are constantly varying; but the fact that we have on hand two weeks' supply means a lot.) We ordinarily consider four weeks' supply as a danger minimum and

add two weeks to this to allow for the report coming out only twice a month. In every instance where the stock on hand is less than the minimum stock allowance, we enter the figure in red. This acts as a danger signal and, as explained later, steps are at once taken to see that more of that material is shipped and received.

The minimum ordering time is calculated two or three times a year for each group of materials, and includes the following:

1. Purchase time, which should be the time necessary for the vendor to receive the order and, if necessary, to manufacture the goods.
2. Transit time.
3. Minimum stock allowance of two to four weeks.
4. Report allowance of one to three weeks. (The longer the interval between issues of the purchase schedule the bigger the figure necessary.)

For example, in the case of oil of peppermint the minimum ordering time is at present seven weeks, of which three cover the purchase and transit times, three the minimum stock allowance, and one the report allowance.

If the sum of the stock on order and on hand is less than the minimum ordering time, the figure is entered in red. This danger signal indicates that another order should be placed for that material. In the case of contract orders, we have set 20 weeks as the minimum ordering time for all materials, and whenever the total stock on hand, on order, and on contract, is less than 20 the figure is entered in red.

All orders go through the purchasing agent although most of them originate with the stores clerk. The purchase schedule is not used as the originator of all orders, although this could be easily done and the practice

CONVERSION SHEET
BEECH-NUT PACKING COMPANY
Canajoharie, N.Y.

DATE Jan 19,1924 Sheet A

PRODUCTION ESTIMATE			CONVERSION FACTOR	MATERIAL SCHEDULE		
Product		Weekly Average 7 Weeks		Weekly Average 7 Weeks		Material
REGULAR MINTS	Peppermint	60,600	0.050	3,030	4	Oil of Peppermint
			1.0	60,600	17	Peppermint Conf. Boxes
			20.0	1,212,000	26	Peppermint Conf. Labels
	Clove	44,700	0.050	2,230	3	Oil of Cloves
			1.0	44,700	16	Clove Conf. Boxes
			20.0	894,000	25	Clove Conf. Labels
	Wintergreen	48,700	0.0246	1,200	5	Oil of Wintergreen
			1.0	48,700	19	Wintergreen Conf. Boxes
			20.0	974,000	28	Wintergreen Conf. Labels
	Cinnamon	19,500	0.048	936	2	Oil of Cassia
			1.0	19,500	15	Cinnamon Conf. Boxes
			20.0	390,000	24	Cinnamon Conf. Labels
	Spearmint	12,500	0.040	500	6	Oil of Spearmint
			1.0	12,500	18	Spearmint Conf. Boxes
			20.0	250,000	27	Spearmint Conf. Labels
			0.120	1,500	37	10½"x10½" Waxed Paper
	Total	186,000	0.1613	30,000	10	2½" Tin Foil
			0.0538	10,000	36	2¼"x12" Waxed Paper
			0.1612	30,000	41	Confection Cartons
SAMPLE MINTS	Peppermint	1,000	100.0	100,000	30	Peppermint Sample Labels
	Spearmint	500	100.0	50,000	31	Spearmint Sample Labels
	Wintergreen	750	100.00	75,000	32	Wintergreen Sample Labels
	Total	2,250	0.444	1,000	11	1⅝" Tin Foil
			1.0	2,250	20	No 7 Sample Boxes
Total Mints		188,250	0.250	47,000		
Total Caramels		75,000	0.091	6,820	197,820	B-38 Granulated Sugar
Total Conserves		110,000	1.31	144,000		

FIG. 5 CONVERSION SHEET WHICH AIDS IN PREPARING MATERIAL SCHEDULE FROM PRODUCTION ESTIMATE

made of ordering no material unless it showed red on the schedule. There are several reasons why this is not done, the principal one being that many of our orders are placed ahead for shipment at specified dates. Also, it is often advisable to take advantage of unusually low prices and order material considerably in advance of needs. The purchasing agent and stores clerk have a wide latitude for the use of their judgment in ordering, and they are not bound by red tape or hindered from free action in any way by the purchase schedule.

As a supplement to the purchase schedule, we have special curves for a few important items that need close watching. We make these curves for such materials as sugar, foil, jars, semolina, etc., which are bought in great quantities and which would either

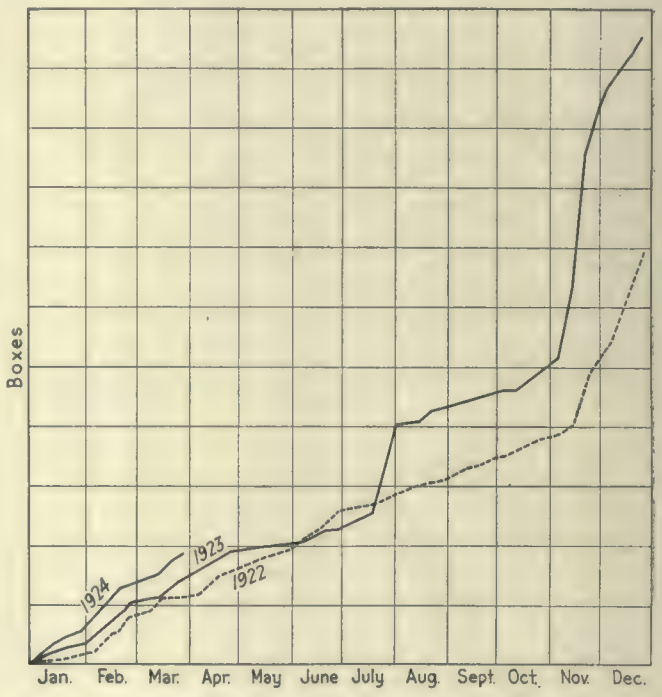


FIG. 6 CUMULATIVE CURVES USED AS BASIS FOR MATERIAL SCHEDULE FOR MISCELLANEOUS ITEMS

accumulate or run short if we did not watch the ordering most carefully. Figure 8 is probably self-explanatory. The orders and estimated usage are put on the sheet in pencil, and the material received and used in inks of different colors.

If there is sufficient material on hand and the purchase schedule shows a sufficient amount of material on order, it is assumed that the specified shipping dates are O K. If, however, the stock on hand is less than the minimum stock allowance, the exact status of that material will be looked up, and, in this investigation, if it is found that the shipping date is too far away, it will be changed. In looking up the status of material, a work sheet called the purchase schedule supplement (Fig. 9) is used. The purchasing department follow-up clerk has the latest information on all orders and the information for the supplement is obtained from him. Due to the delay in balancing the stores books and in making the necessary entries and calculations on the purchase schedule, the latter

PURCHASE SCHEDULE
BEECH-NUT PACKING COMPANY
Canajoharie, N. Y.

SHEET. A DEPT. Mints DATE Jan. 19, 1924

	MATERIAL	MATERIAL SCHEDULE Weekly Average For Next 7 Weeks	ON HAND Quantity	ON HAND Weeks *	ON ORDER Quantity	ON ORDER Weeks	Total on Hand & on Order Weeks †	Minimum Ordering Time Weeks	ON CONTRACT Quantity	ON CONTRACT §	Total on Hand on Order & on Contract 7 Weeks Schedule Weeks	Total on Hand on Order & on Contract 20 Weeks Schedule Weeks	REMARKS
1	Raw Stock - lbs												
2	Oil of Cassia	936	8400	9			9	7					
3	Oil of Cloves	2,230	13400	6	8,900	4	10	7					
4	Oil of Peppermint	3,030	18,200	6			(6)	7					15,000 ordered 3/1/24
5	Oil of Wintergreen	1,200	2,500	(2)	7,200	6	8	7					
6	Oil of Spearmint	500	1,530	(2)	1,000	2	(5)	7					2000 ordered 3/1/24
7													
8													
9	Foil - lbs												
10	2 x 2 Tin Foil	30,000	255,050	8½	105,000	3½	12	9					
11	1¾ Tin Foil	1,000	7,010	7	3,000	3	10	9					
12													
13													
14	Confection Boxes												
15	Cinnamon	19,500	292,000	15			15	10	137,000	7	22	21	
16	Clove	44,700	223,000	(5)	314000	7	12	10	580,000	13	26	24	
17	Peppermint	63,600	486,000	8			(8)	10	1,212,000	20	28	27	250,000 ordered 3/1/24
18	Spearmint	12,300	50,000	(4)	87,500	7	11	10	113,000	9	20	(19)	100,000 contracted 3/1/24
19	Wintergreen	46,700	340,000	7	290,000	6	13	10	487,000	10	23	22	
20	No. 1 Red Sample	2,250	22,510	10			10	10	20,300	9	19	(18)	awaiting instruct
21													
22													
23	Confection Labels												
24	Cinnamon	390,000	4,700,000	12	No				7,800,000	18	30	28½	
25	Clove	684,000	13,500,000	15	withdrawal				12,500,000	14	29	27½	
26	Peppermint	2,2,,000	12,20,000	10	orders				26,800,000	22	32	30	
27	Spearmint	250,000	3,250,000	13	are				3,000,000	12	35	33	
28	Wintergreen	974,000	20,500,000	21	made out				4,600,000	4	26	24	
29					for								
30	Peppermint Sample	100,000	210,000	12	Confection				2,800,000	28	40	38	
31	Spearmint Sample	50,000	1,044,000	21	Labels				0	0	21	(19)	500,000 contracted 3/1/24
32	Wintergreen Sample	75,000	974,000	13					1,130,000	15	28	26½	
33													
34													
35	Paper - lbs												
36	2 - x 12" Waxed	10,000	80,300	8	70,000	7	15	12					
37	2 x 10½ Waxed	1,500	6,100	(4)	13,500	9	13	12					
38													
39													
40	Miscellaneous												
41	Confection Cartons	30,000	211,100	7			(7)	8					150,000 ordered 3/1/24
42	Mint Pummies	1,000	4,980	(5)	4,000		9	8					
43													
44													
45													

* Red indicates less than minimum stock allowance and orders should be followed up closely

† Red indicates less than minimum ordering time and another order should be placed

§ Red indicates less than minimum contract time and another contract should be placed

FIG. 7 PURCHASE SCHEDULE USED AS A CHECK ON PURCHASES

is usually not completed before a week or so after the date for which the figures are effective. For this reason it is usually found that some of the "danger" materials have arrived during the above interval; also, in many cases where the material has not been received, it is found that it has been shipped. If no material or an insufficient amount has been shipped, or if the material needs to be hurried up in transit, the necessary action is taken by the purchasing department. If there is a freight shipment en route and the stock on hand is very low, it may be necessary to have an auxiliary express shipment made. In some cases it may be necessary merely to advance the shipping date or ask for an immediate freight shipment. In other cases it may be found that the shipping date is satisfactory, and that only a tickler need be placed to see that shipment is made as specified.

Follow-Up Sheet

After filling in the purchase schedule supplement, those items which have not been eliminated are put on a special follow-up sheet for future reference (Fig. 10). Red on the follow-up sheet indicates that the follow-up clerk should see that the material is received as well as shipped. That is, as L. C. L. freight shipments cannot be traced, it might be necessary to order an express shipment during the interval between that and the next issue of the purchase schedule.

It may be noticed that the purchase schedule is a check on running out of stock, but is not so much a check on building it up. This is true but it is also more or less unavoidable. To have red figures for materials of which there is a big stock on hand or on order would complicate the report and would be of little use. If too much material is already here it cannot be helped; and if a lot is on order, it may be due to the fact that orders have been placed far ahead for future shipment. Also, as explained above, advantage is often taken of low prices to stock up on certain materials. The only way to keep stocks low is to watch the ordering, and if the purchase schedule is referred to, as it should be, no material would be ordered where we already have a big stock, unless there was some good reason for so doing.

It might be considered advisable, by some, to have on the purchase schedule, in addition to the material schedule, a column showing the material used during the past month or two. This was considered by us but it was decided that it would be more or less superfluous, as the material schedule takes into account both past sales and past usage in estimating future needs. The purchase schedule might also be operated *entirely* on a basis of material used by substituting material used figures for the material schedule figures. This would not be very satisfactory, however, as one would always

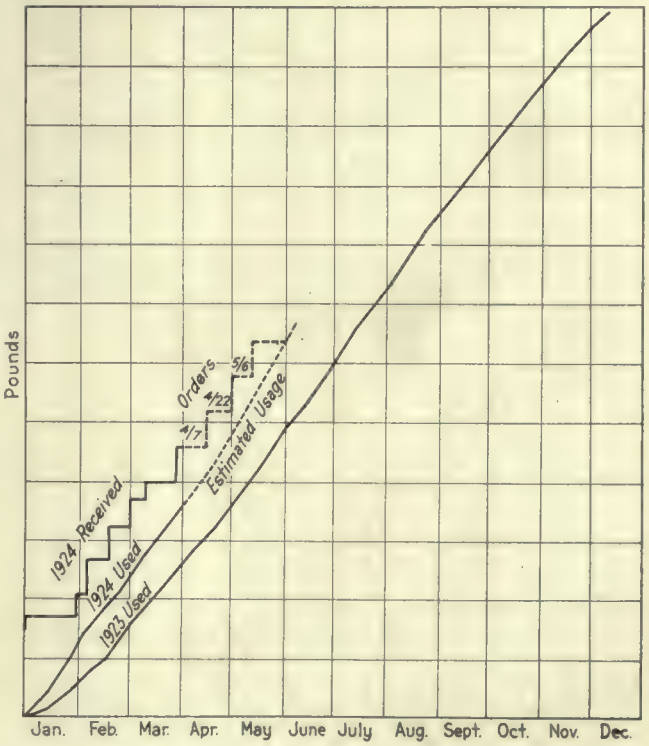


FIG. 8 SUPPLEMENTARY CURVES FOR ITEMS OF PURCHASE SCHEDULE REQUIRING CLOSE ATTENTION

PURCHASE SCHEDULE SUPPLEMENT
BEECH-NUT PACKING COMPANY
Canajoharie, N. Y.

DATE Jan. 19, 1924

MATERIAL	MATERIAL SCHEDULE Weekly Average For Next 7 Weeks	AS PER PURCHASING DEPT. RECORDS: ORDERED Date	ORDERED Quantity	ORDERED Shipping Date	SHIPPED Date	SHIPPED Quantity	RECEIVED Date	RECEIVED Quantity	On Order (as per Purchase Schedule) Quantity	STOCK ON HAND (as per Purch Sched) Weeks	RECEIVED (But Not Included in Purch. Sched Stock On Hand) Quantity	RECEIVED Weeks	REVISED STOCK ON HAND Weeks *	SHIPPED (But Not Yet Rec'd) Quantity	SHIPPED Weeks	STOCK ON HAND & in TRANSIT Weeks †	BALANCE TO BE SHIPPED Date Ordered	Quantity	Shipping Date: Latest Revised	Shipping Date: Weeks Distant	Shipping Date: Weeks Leeway	ACTION TAKEN	TICKLER SET FOR Date
A-5 Oil of Wintergreen	1,250	2/12	5,000	3/10	3/5	2,200	3/5	2,200	3,200	2	2,200	1 3/4	(3 3/4)	—	—	(3 3/4)	2/12	5,000	3/10	1 1/4	2	letter 3/4	3/12
" Oil of Spearmint	500	1/15	1,000	2/3	2/3	1,000	—	—	000	3	—	—	(3)	1,000	2	(5)	—	—	—	—	—	2,000 ordered 3/7	3/14
10 Steel Surf Boxes	400	3/3	3,000	20 mos	2/29	3,400	3/5	3,400	3,400	5	3,400	7	12	—	—	12	—	—	—	—	—	—	—
1 Spearmint Oil Case	2,500	2/2	17,500	60 mos	3/3	17,500	—	—	17,500	4	—	—	4	17,500	7	11	—	—	—	—	—	—	—
5" " " Mint Paper	500	3/3	3,500	3/5	3/7	3,500	3/2	3,500	3,500	4	3,500	2 1/4	6 1/4	—	—	6 1/4	—	—	—	—	—	—	—
#2 Mint Dummies	1,000	1/29	4,000	3/15	—	—	—	—	4,000	5	—	—	5	—	—	(5)	1/29	4,000	3/15	2	3	none	3/17

FIG. 9 PURCHASE SCHEDULE SUPPLEMENT IS A WORK SHEET, FOR IT CONTAINS LATER INFORMATION THAN PURCHASE SCHEDULE

be behind the game instead of ahead without much chance for co-ordination with sales and production.

MATERIAL FOLLOW-UP SHEET
BEECH-NUT PACKING COMPANY
Canajoharie, N. Y.

DATE Jan. 19, 1924

MATERIAL	REVISED STOCK ON HAND Weeks*	ON ORDER Date	ON ORDER Quantity	FOLLOW UP TICKLER SET FOR	SHIPPED Date	SHIPPED Quantity	REC'D Date
Oil of Wintergreen	(3 3/4)	2/12	5,000	3/12			
Oil of Spearmint	(3)	1/15 3/7	1,000 2,000	3/14	3/3	1,000	
Mint Dummies	5	1/29	4,000	3/17			

FIG. 10 MATERIAL FOLLOW-UP SHEET

The necessity of keeping track of stores apportioned is not necessary in our business as we make only standard products in quantity and in straight-line production. That is, we always have approximately the same amount of material in process when a department is running.

In conclusion, although each business has its own particular problems which, it is realized, can be solved only by the study of those very problems, it is believed that much help can be obtained by learning what other concerns have done along similar lines. While it is rarely advisable to transplant a system or set of methods intact, it is often possible to make use of other people's methods by making the necessary variations or modifications. It is with this idea in mind that the above system of purchase control is presented at this time. It has proved to be of value at the main plant of the Beech-Nut Packing Company, and it is hoped that it will be of equal value to others.

Recreation That Pays

COMMUNITY gardens for employees will be as valuable this year as ever before. Although the cost of living may have decreased to some extent since the end of the war, there is still a splendid opportunity for aiding the family budget by means of produce grown in community gardens.

Many industrial concerns make gardening a concrete employee activity. The company plows its vacant land held for future plant expansion, or even rents land from private owners. The plowed land is divided into lots varying in size with the amount of land available and the number of employees who wish to have a garden.

Properly conducted, this co-operation by the company is greatly appreciated by the employees, especially in the fall and winter, when the results of their harvest are in their cellars. When the price of vegetables rise, the amateur gardeners are very thankful for their summer's industry.

Gardening is an occupation that pays in other ways besides storing up vegetables for winter use. It pays in health by giving men, who ordinarily might spend their entire day indoors, an opportunity not only to be out of doors, but to exercise all their muscles.

Gardening pays by eliminating much indiscriminate spending. A considerable portion of a man's money is spent for the sole purpose of killing time—to have something to do. Proper upkeep of a garden does not leave much time for spending money. This is evidenced by the increased regularity of savings deposits and increase in thrift activities in communities where gardens are common.

Of considerable value to employers is the fact that by means of his garden the employee obtains a realization of the productive possibilities of increased energy. In the modern factory few employees have a true conception of the final value of production. Production has simply meant the monotony of turning out more pieces. From his garden experience, the employee knows what a little additional energy produced for him; therefore, a call for greater production in the factory means something to him and finds him more willing to answer it.

Gardening should be further encouraged by factory managers, industrial relations or personnel departments, and employees' clubs. The company can aid the project by furnishing idle land, by plowing it, by buying seeds in quantity through its purchasing agent and distributing them at cost, by issuing instructions on proper gardening methods, and by offering prizes.

Getting Rid of the Export Box

Resulting Selling Price Reductions Will Open New Markets

By GEORGE F. BAUER

Secretary, Foreign Trade Committee, National Automobile Chamber of Commerce

PACKING methods and shipping procedure followed by or forced upon manufacturers, and holding selling prices to high levels, account for no small measure of the sales limitations from which many producers suffer at home and abroad. This may seem to be a rash statement based more upon supposition than upon fact. However, the progress already made by some concerns in price reduction through lowering the cost of packing goods for shipment shows that the thing can be profitably done.

The present article, dealing with the problem facing exporters of automobiles, is typical of what almost every shipper has to meet. The restriction of sales suffered abroad by automotive manufacturers may be attributed to a great extent to the cost of the shipping container. If this container could be practically eliminated — and it can—the resulting price reduction would bring motor vehicles within the reach of an increasing number of people in all foreign countries. Incidentally, the ability of American producers to compete with foreign makers would be enhanced very considerably in all parts of the world.

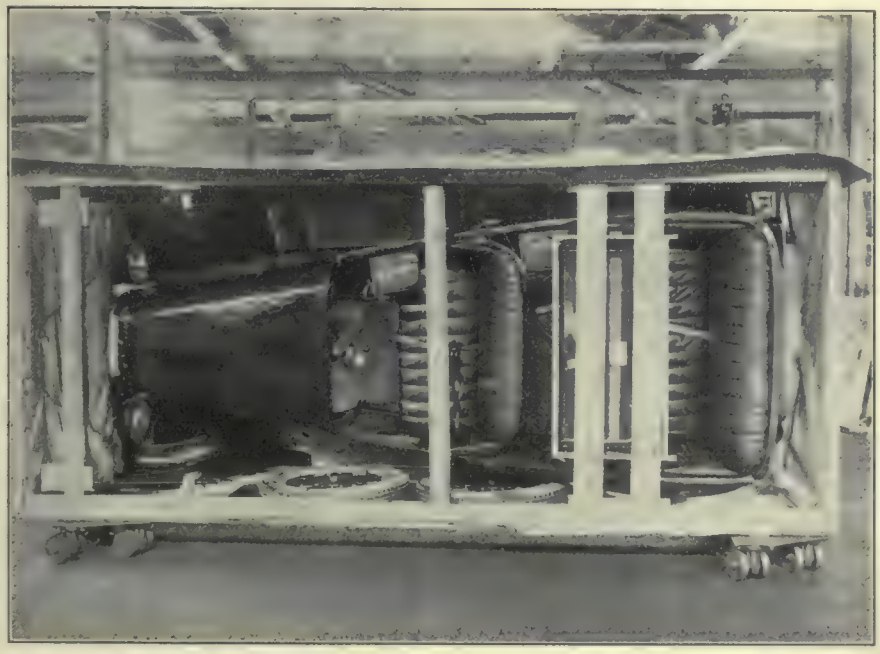


FIG. 1 METHOD OF CRATING TOURING CARS FOR EXPORT

Motor vehicles to the number of 3,523,679 were produced in the United States in 1924, and of these 505,590 were shipped abroad. Probably 225,000 were crated before going to their foreign destinations. The average cost per car for this crating was initially about $40, but because of pyramiding due to miscellaneous causes, the final cost more likely approximated $65.

Here then was incurred a total annual expenditure of about $13,500,000 that in no way can be considered productive. It neither provided improvements justly to be expected in the motor vehicles for the outlay incurred by the user, nor increased profits to the seller or manufacturer.

What is to be done to prevent the recurrence, year after year, of this huge economic loss? This problem apparently cannot be solved separately by the various groups engaged in the manufacturing, conveying and distributing of American motor vehicles to people throughout the world. Can it be solved, however, through the collective efforts of all these groups? The question merits serious consideration.

At an export meeting of the National Automobile Chamber of Commerce, J. D. Mooney, President of General Motors Export Company, in referring to a survey of foreign markets that he had made, emphasized the need of lower cost abroad for the purchase and maintenance of automobiles in order that the potentialities of the world for motor transport might be developed to the fullest extent.

How high cost is retarding motor transport even more effectively than lack of roads was brought out by M. A. Cocco, who represented the Dominican Republic on the Pan American Highway Commission, which recently inspected American methods of highway construction. He stated that although his country had 1,000,000 inhabitants only 3,000 automobiles were in operation there. A fairly adequate system of highways already exists, but the greatest deterrent appears to be in the high price of motor cars.

Mr. Cocco felt that the price differential between the cost in the United States and that in the Dominican Republic was entirely too great. As the Dominican government imposes only a reasonable duty, he thought that the cause might rest in the freight rate or some kindred place. Although he did not point to any specific reason why such a situation should exist, he inferred that until the cost of the vehicle comes within the means of the people of the Dominican Republic,

TABLE 1. COSTS OF CRATING AUTOMOBILES FOR EXPORT

These amounts do not include increased shipping charges, marine insurance, counsel fees, etc.

Make	Charge	Make	Charge	Make	Charge
Apperson	$75	Gray	$50	Oakland	$41
Buick	42	H. C. S.	75	Oldsmobile	46
Chandler	50	Haynes	85	Overland	37
Chevrolet	37	Hupmobile	50	Paige	63
Chrysler	65	Jewett	54	Pierce-Arrow	115
Cleveland	50	Jordan	100	Rickenbacker	75
Cole	75	Lexington	90	Rollin	50
Davis	50	Marmon	100	Stutz	102
Durant	35	Maxwell	55	Velie	60
Elcar	45	McFarlan	75	Westcott	50
Franklin	50	Moon	55	Wills St. Claire	100
Gardner	50	Nash	50	Willys-Knight	43

further development of highways would be arrested.

As stated, $40 is the average charge made by the manufacturer for the export crating of an automobile selling at the factory for about $500. On medium and higher-priced cars, this cost will, of course, be greater, as can be seen from Table I. The amounts listed are solely for the actual cost of constructing the crates, and do not include the additional indirect charges resulting from non-standardized methods of shipping employed in United States. Neither do they take account of the loss in shipping an automobile that weighs only 2000 lb., in a container that weighs 1000 lb., or one-half as much as the product.

To transport 225,000 vehicles abroad, means that 375,000,000 lb. of actual merchandise and 187,500,000 lb. of dead weight has to be carried on the American railways, in the holds of ships, and on foreign railways before the cars arrive at their destinations. Would such an arrangement be deemed economical in domestic trade? If not, should it be necessary in international commerce, where competition is keener and savings achieved mount large when converted into currencies of people with lower purchasing power?

Items of Increased Freight Cost

Among the increased charges due to crating are larger marine insurance premiums. These premiums are based on the value of the shipment, including boxing, at port of departure. Many consular fees are ad valorem and amount to as much as 5 per cent of the cost of the shipment ready for transit to the foreign country. The consular fee on a crating cost of $40 for overseas shipment is hence increased by $2.

Some countries, such as Czechoslovakia, have a practice of assessing ad valorem duties on the c. i. f. value of the shipment at place of entry. With a duty on automobiles of 45 per cent, which certain countries, including the one just mentioned, apply, it is evident that an increased tax of $18 may be added to the initial boxing charge of $40 for a low-priced car.

It also happens that internal taxes are sometimes assessed against a car on an ad valorem basis. In Czechoslovakia, this tax is 10 per cent, so that $4 additional has to be paid on a $40 crating cost for shipments to that country.

The instances given are duplicated in other countries with little variation. The item of crating has consequently crept up until it actually represents 13 per cent of a $500 car. This is close to the actual discount allowed to dealers in low-priced cars in the United States. But while at home the money represented by this 13 per cent goes to reward strenuous efforts incidental to the selling of merchandise, abroad, as crating costs, it is an absolute economic waste. Moreover, any work having as its objective an ultimate reduction in such crating costs will convert a large number of potential users into actual users of motor transport throughout the world.

Present Crating Methods

Present methods used in shipping automobiles abroad call for the packing of complete cars in separate crates, whereas chassis frequently go forward two in a box. Considerable dismantling is also done in order to reduce the cubic contents. All movable parts are securely fastened and those subject to rust are properly greased. Batteries are made bone dry, the oil, water, and gasoline are drained, and the tires deflated.

Ample clearance for the vehicle is provided in the

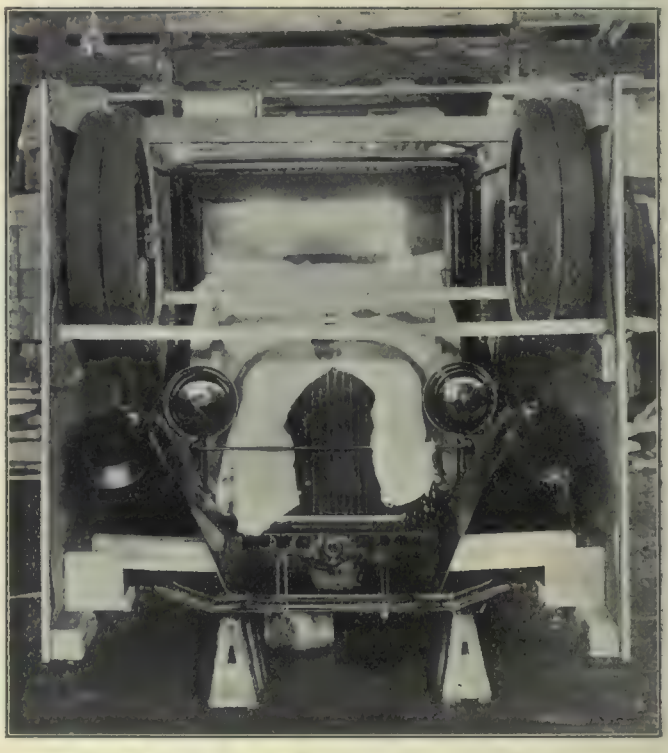


FIG. 2 METHOD OF CRATING SEDANS FOR EXPORT

crate, which is made of a good grade of lumber. The crate frame is specially rigid as result of re-enforced corners and employment of cement-coated nails that are clinched whenever possible. All nuts are locked with washers to guard against lumber shrinkage. Special precaution is also taken in constructing the sides of the crates, so that no damage will occur from heavy articles that may be placed upon them in holds of steamers. (See Figs. 1, 2 and 3.)

Considering the weight involved, and the need of handling and re-handling of the crates, there is no doubt but what boxing of automobiles as a process has been sufficiently developed even to the point of progressive assembling that is so effectively employed in

the actual manufacturing of automobiles. Under the circumstances, there appears but little chance for the improvement of automobile crates themselves.

What is needed, however, is not improvement of crating as an individual item, but consideration of plans whereby the whole system of transporting automobiles abroad may be advanced to a point of real efficiency and economy. Crating should preferably be eliminated in any future projects looking to more economic shipment of automobiles to foreign countries. Already there are signs of such a transition. Efforts are being made to introduce methods that will deliver American cars at lowest possible costs to buyers abroad.

Outstanding among these developments is, perhaps,

FIG. 3 HOISTING CRATED AUTOMOBILES FROM DOCK INTO STEAMER'S HOLD

the increasing practice of establishing assembling plants abroad. Some of the larger companies are doing this in parts of the world where a sizeable demand already exists for their product. Such a method is possible and profitable whenever the disadvantages of interest on investment, less advanced type of machinery, lesser efficiency of workmen, and high overhead can be offset by savings in duties and freight charges, resulting from smaller values and greater compactness in shipments of parts and consequent reduction in ad valorem values. Further extension of this practice is limited, of course, by the resources of the company concerned and the number of places where such an investment is warranted by sufficient demand for the output.

Fitting Steamships to Carry Uncrated Cars

Another plan is to equip steamships in such a way that complete cars can be readily transported. On the Great Lakes this arrangement has been provided for a long time. Fig. 4 shows the method of shipping automobiles adopted by the Nicholson Transit Company, which is located in Detroit, and which arranges for shipments of assembled cars in the Great Lakes traffic.

The picture is of the steamer Sultana, formerly an ore vessel but now converted to handle automobiles exclusively. An elevator rigging is provided in the center of the boat. Automobiles can be driven onto the boat under their own power and conveyed by this elevator to the deck where they are to be located. After the hold and lower decks are full, the upper deck load is put on and the steamer is ready to depart. Due to the absence of a rough sea, there appears to be no need for special blocking. The brakes of the automobiles are set and this alone is sufficient to keep the vehicles in place.

In Copenhagen, Denmark, a former German cruiser has been converted by the Ford Motor Company to export complete vehicles from the assembling plant located there to adjacent countries. The ship was built with three stories of storage space for the cars, which were simply driven on board and driven off upon arrival at their destination. This arrangement, it is reported, proved highly satisfactory to the dealers as the need of crating and re-assembling was eliminated.

Shipping Uncrated Cars Abroad

The development of major interest to all automotive exporters, however, will be found ultimately in the establishment of facilities by general steamship lines for handling of uncrated automobiles from American ports at no greater expense to shipper than if vehicles were boxed.

The Ward Line has already undertaken this method of shipment. Automobiles, towed or under their own power, are now driven to the docks of this company and there run onto latticed platforms provided for the cars. The wheels fit into hollow cavities or grooves on the platforms, from which they cannot move except by the application of some outside force. The platforms are fitted with roller attachments and can be moved to any point which is most convenient for loading onto the ship.

The sling of the ship's derrick is fastened to the four corners of the platform, which, with the automobile, is hoisted high enough to clear the side and then is lowered to the first lower deck. There the automobile remains on the platform, but is held secure by ropes from the wheels to the flooring. To avoid damage to the car heavy tarpaulins are used as covers and are securely fastened to the platform.

Upon arrival at the destination the tarpaulins are removed and the platform and automobile are hoisted by derrick onto the dock. No uncrating or re-assembling is required and the automobile is at once ready for use.

The charge for this service is based on actual weight and not on space. There is no economic urge to resort to boxing as a means of reducing cubic contents and consequently the freight cost.

Advantage of Weight Basis in Freight Charges

If the practice of charging freight on basis of weight rather than cubic contents were generally adopted by steamship companies, and even if the total freight cost on an uncrated car remained as much as on a crated vehicle, a great step forward would be made. The

shipper would know that for steamship transportation the expense would remain the same per car, regardless of whether crating were used or not. His efforts would naturally be toward eliminating the crating factor that now increases the cost of his product to the ultimate consumer by 13 per cent.

Steamship Companies Are Protected

From the viewpoint of the steamship company there can be no doubt regarding the practical possibility of transporting uncrated automobiles overseas. The service of the Ward Line proves its feasibility. As regards space, it is true that more would be required for uncrated automobiles, but, from the standpoint of revenue, the income on the same number of vehicles would remain identical with that under present arrangements. In the final analysis the returns to the steamship companies would be larger, as more people abroad would buy cars if a reduction of 13 per cent in price were passed on to them.

Recognition of these facts is essential to a proper understanding of the need of eliminating export crates for automobiles. With the co-operation of the steamship companies one of the main obstacles to the attainment of that goal can be readily overcome.

Another barrier apparently exists in the freight schedules of the American railroads. At the present time the charge on domestic shipments is $1.22 per 100 lb. and the export rate, presumed at least to be such, is $0.82 per 100 lb. As a matter of fact, however, this is not strictly an export rate, as in the case of grain, because it is accorded only on crated automobiles. Uncrated cars come under the $1.22 rate. This arrangement, therefore, favors indirectly the continued shipment of crated cars to foreign countries. Once the export rates are extended by the railroads to uncrated automobiles, a decided stimulus is certain to be given to elimination of the export crate, and the only other major obstacle to that goal on the part of the transportation companies will have been removed.

The other angles are minor. Insurance cost would be slightly, if at all, increased. The attitude of the foreign dealer is certain to be favorable, as he reduces the sales resistance on his product by the saving of crating and re-assembling.

It is difficult to forecast the benefits that would accrue directly to all industries now engaged in manufacturing, transporting and distributing motor cars for export, in event that the export crate is eliminated. The present visible increase in sales as a result of saving $13,500,000 in crating charges alone would amount to about 6,000 more car purchases each year by people abroad. The saving would indirectly sell a great many more.

How great an increase in automotive export trade may result from causes indirectly linked up with this saving is hard to foretell. However, there is certain to be an ever-expanding circle of potential customers capable of buying more and more automobiles as prices are brought down within the purchasing power existing in the various countries not only of Europe but also of the entire world. Automobile manufacturers of the United States can secure a large share of this trade by getting rid of the useless crate and reducing prices accordingly.

Problem Concerns All Shippers.

The problem is by no means limited to the automotive industry. The benefits arising from its solution extend to practically every line of manufacturing activity. Reduced costs in the shipment of automobiles can be paralleled by corresponding reductions in other branches of industry if shippers, railroads and steamship companies co-operate in the effort. The opportunity exists, the work is new, and the rewards in money saved, sales increased, outlets broadened, and profits realized, are great enough to fire the ambition of any man who will join in the effort to bring them about.

FIG. 4 NICHOLSON TRANSIT COMPANY'S METHOD OF SHIPPING AUTOMOBILES ON THE GREAT LAKES

This boat is a converted ore carrier used solely to transport automobiles. Cars are run on the steamer under their own power. On the upper deck they are merely driven to the proper location and the brakes are set. No blocking is necessary. A freight elevator on the boat carries down those which are to be shipped on the lower decks or in the hold.

Profit-Making Possibilities in Seeing Marketing Essentials

Work of the Industrial Executive—VII

By B. A. FRANKLIN

Vice-President, Strathmore Paper Company

THERE is in industry no problem more fascinating than that of marketing the products of the industrial unit.[1] It has to be solved over long distances, and deals with human natures not under executive control. It is so apparently full of chance, resting, as it so often does, in the hands of unknown and uncontrollable salesmen. It is so fluctuating, so essential to success, so alluring in its hopefulness, so discouraging at times in its unresponsiveness, so subject to general external conditions. It is a problem of imagination and human nature. It has mostly been considered a problem for special talents, and has often been a matter of spectacular exploitation. It has been least attacked by principles of scientific management.

It is in principle the simple problem of placing the wares of the industrial unit frankly before the public eye, and the intricate problem of really catching the public eye persuasively. And yet in marketing results lies the whole crux of industrial success, both from the point of view of service and of profit.

It is the only industrial problem that is strictly competitive. One industrial unit may have differing methods, a different class of labor, a different layout of factory and machinery, and different policies, but when the results are put on the market, these results must compete with the results of other like producing industrial units, and thus, both in quality and cost, become the gage of the effective value of the industrial unit and, indeed, of the work of the industrial executive and his organization.

Herein, then, lies an important point of view for the industrial executive, that the buying public, in whose service he is by the very nature of industry, and from whom he expects to derive a profit through the marketing of his product, offers him the only effective chance to gage the value of his work and his unit, in comparison with that of competing units.

This point of view should give the industrial executive pause. He will do well to keep this judgment of the buying public constantly in sight and give it a searching examination and a critical interpretation as to the value of his products and his methods, his equipment and his organization. When the judgment is favorable, the marketing problem is not difficult. When the marketing is difficult there can be no doubt, if the state of the business cycle be not in opposition to all good business, that changes are necessary. And this idea applies equally to each product in a group, even in a successful unit, as it does to the whole group. The necessary change may be in the article, the method of marketing, or in the organization.

Marketing is the concluding operation of the industrial round—the crucial test which determines with finality whether the industrial executive is a success or a failure, and, in either case, the degree of this success or failure. But the failure—if it be a failure—may be in the marketing itself. Very fittingly, therefore, Mr. Franklin devotes this, the last of his "operating" articles, to a discussion of the more essential requirements of successful marketing.

This careful attention to the attitude of the buying public is important because it leads to the first essential of good marketing, i. e., sensitiveness to the public's wants and desires. The public has two standards of judgment—quality and price. The market divides itself into three main divisions which must be considered—that section of the public which desires quality somewhat regardless of price; that section which desires certain qualities with not an excessive price; and that section which considers price the most important element.

With a growing population and an increasing standard of living, there is a vast public want in the United States, not to mention other parts of the world, and this public want is growing in its standards, as well as in its quantity demands so rapidly as to keep a sensitive industry constantly and reasonably busy, to say nothing of the demand for new inventions and discoveries; and to these public wants must be added the great needs of industry itself through its very operation. The markets of the world are increasing and must continue to do so for the next quarter of a century. This is an enheartening feature for industry.

This sensitiveness must not, however, be confined to a present market, but must be constantly alert to the realization that the public want is a changing one. Fashions, styles, pleasures, modes of living, are all operating to bring about change in public demand.

A carpet manufacturer finds himself compelled to make rugs or go out of business. A harness company sees its only hope in automobile accessories.

[1] For preceding articles see MANAGEMENT AND ADMINISTRATION for September 1924, p. 249; October 1924, p. 391; November 1924, p. 513; December 1924, p. 611; January 1925, p. 21; February 1925, p. 149.

On the other hand, certain dangers have arisen as a result of attempts to express this sensitiveness. Many industrial units have so multiplied the articles of their production as not merely to create an extra cost in their manufacture through the variation, but an added cost because of reduced making orders, smaller shipping orders, larger inventories, loss through misjudgment and obsolescence. The shoe manufacturer finds himself suddenly with 3000 styles. An axe and tool manufacturer discovers he puts out 2700 articles, actually satisfactorily reducible to 700.

Problems of Standardization

This multiplication creates higher costs or lower profits, and has brought about the effort of the Department of Commerce, in its "Simplification and Standardization" program, to assist manufacturers generally in discovering the reasonably proper shapes, forms, sizes, and styles and quantities which may be manufactured as a maximum and standard group. This movement on the part of the Department of Commerce deserves the heartiest co-operation of all industrial executives as a matter of self-interest, and they can most easily prove this to themselves by a constant computation of comparative volume of sales of all their separate products. It will usually be found, unless considerable study and care has been previously taken, that many variations may be eliminated with small deductions of volume and disproportionately larger reduction of cost. Simplification and standardization of product form a second important element in marketing, and have a definite relation to production and cost. Oddly enough the first attitude of executives is against simplification and standardization because change seems expensive and difficult. Usually, however, the results are very beneficial.

A third important element in marketing has to do with the locality of markets. The desire for volume of the American manufacturer, based on the idea of reduction of unit cost, expansion of output and plant, and increased profits, together with a laudable idea of pride in wide distribution, has caused many to consider their field of marketing to be no less than the whole of the United States, and in some cases the whole world.

It is a fact, however, particularly in the cheaper staple articles, that many concerns cover their more distant markets at an actual loss, if sales costs are calculated by zones of distribution. In making such calculations, however, the true facts can only be presented if two further considerations are made—the reduction in cost made over the whole production by increase of volume, and the eventual possibilities, in time, of profitable increase in losing localities.

Marketing Along Lines of Least Resistance

A logical solution, then, of this phase of marketing is to work the territory in circles, extending in larger radii perhaps, but centering on the industrial unit, and reaching first and most intensively the nearest points, and then the more distant points, where these are, mostly, equally distant from like industrial units. Where the article is a specialty, or has its own peculiar virtues, the most thickly populated centers offer the first best markets naturally.

Of course, the natural market for any industrial unit because of transportation, quick communication and ease of personal touch, lies nearest the unit, and it would seem wise that this should be most intensively operated as it is easier to reach and retain. To work a market intensively, however, requires two important preparatory steps.

There should first be a survey of the market to estimate the possibilities of sale. Following the survey, a plan should be operated for a fair economical coverage and realization of those possibilities. Too often it occurs that the sales effort is merely a superficial, "high-spot" effort—a gathering of a little here and a little there. The sales effort ought to be just as carefully and scientifically planned as any production effort. Scientific management—industrial engineering—has a very definite place and mission in sales work, and results will just as readily come from such an effort as in production.

An important fourth consideration in marketing has to do with the course of its progress through the market to the actual consumer, for it goes through very varied channels.

The importance of this fourth consideration is found in the two much discussed and perplexing problems—the reduction of the cost of distribution to a minimum, and at the same time, the gaining of the widest distribution and display to the buying public. There is much complaint of the high cost of distribution. It not infrequently happens that this is greater than the actual cost of production. Many minds have worked on the problem, and solutions such as the chain store are developing are offered, but there seems to be in the problem of wide distribution no great hope that any revolutionary reduction of distribution cost will come about. Certainly it will not so long as the centers of distribution are so numerous and in such small units as they are in America, where so many in their ambition to own independent businesses, start up small stores in increasing numbers.

The Problem of Wide Distribution

What most executives are interested in principally, however, is to get a wide and intensive distribution. This is really the important and consuming problem of the ordinary industrial unit.

Many industries go directly to the consumer. A Southern manufacturer of umbrellas sells a large part of his product from door to door. A large shoe manufacturer has his own stores spread over the country. A leather belt manufacturer has a dozen selling warehouses in large centers and agents in the smaller places. A number of similar instances may be cited. If perchance, and probably, these industrial units cannot maintain mercantile branches any cheaper, if as cheap, as the jobber or independent stores which sell a variety of products, at least they usually get the large distribution which reduces the cost of pro-

duction. Very many industries selling machinery, equipment and supplies, especially to other industries, sell direct. They attain the minimum selling cost.

A great amount of industrial products, however, must be sold through merchants and jobbers necessarily, because either the financial strength of the industrial unit is insufficient to market otherwise, or because the sale of the product is not wide enough to maintain in any section a separate sales unit, and must be combined with other merchandise appealing to a similar public. This group of industrial products represents a very large proportion of the results of industry.

In this phase of distribution lies, then, the main difficulty of the industrial executive—to get adequate representation before the public, since that representation, with varied supplies to sell, is apt to follow the lines of least resistance, and, without exploitation, to let the public choose. In theory this would seem fair enough, except, as the industrial executive sees it, the public needs more information than it ordinarily possesses to make wise choices, and consequently is apt to choose ignorantly.

Advertising as a Selling Force

The industrial executive is then led to a fifth consideration in marketing—advertising. Advertising is merely the practical expression of the executive in the working out of his belief that what his unit produces has a real and wide-spread value to the public eye, and that that knowledge, if he can get it to them, will compel them to buy freely. Whether it is better to advertise in public reading matter, where there is a chance of catching the reader's eye in a broad way, or direct by mail, where chosen individuals are directly addressed, or to employ a judicious mixture of the two, is a matter of serious consideration, but there are certain points about advertising which seem to be generally conceded as true.

In the first place, if a campaign of advertising is entered upon, it is best and most profitable to make the expenditure a fixed per cent of sales to be put in as part of the cost, and the campaign must be a regular and continuous performance. Unless there is some particular idea to be put over at a particular time, only occasional advertising, now in large, now in small sums, is ineffective. No concern ought to enter upon advertising except as a regular thought-out policy of steady operation, if a steady flow of sales is expected to follow, for the public mind, in its demand, is both forgetful and volatile. It needs constantly to be reminded and convinced. A once successful concern recently sold for $30,000 because the inheritor of it discovered that it was spending $500,000 a year in advertising, which she thought was wasteful and might be saved. When the advertisements ceased, the demand for the product fell off.

The Place of Price in Marketing

A sixth consideration and a most potent one in marketing, of course, is price. For strictly competitive articles, the general prevailing market fixes the price. It is, of course, recognized by executives that there are usually in any article some offerings lower in price than others, either because quality is shaded or ignorance of cost exists, and this latter very frequently is the case. It is no gain, either to the public or to the industrial unit and those it involves, that it should enter such a market without complete pre-estimated ability to compete fairly. On the other hand, it is to the interest of the public that competition, acting fairly, by the discovery of more economical production or by changes in the article which shall not deteriorate its serviceability, shall produce the lowest profit-making price.

Modern competition, developing, through its trade customs and ethics, higher bases of fair operation, is producing constantly higher qualities and essentially lower prices in comparison with ability to buy, and this is its economic function.

In a highly competitive market, the higher prices can frequently be obtained by the creation of extra values or advantages in the article offered.

Very often in articles of general and wide-spread use, and even in many articles of irregular use, especially where there is liable to be competition in one locality or between localities, it is valuable to the industrial unit to fix resale prices so that the buyer, no matter where he buys the article, pays the same price. This creates confidence on the part of the buyer, eliminates foolish competition, creates confidence on the part of the merchant in his purchase and sale of the product, permits price advertisement, gives the industrial unit control of the situation, and is perfectly fair to the public, since, while it is essential that a fair profit shall be allowed the merchant, it is greatly to the interest of the industrial unit to make the price as low as possible so as to make it attractive.

Market Surveys

There are many possibilities resting in each of these marketing problems, which a survey, frequently by independent market experts where inside talent seems unavailable, will bring out. Often the requirements and possibilities of the market may be gaged by frank questioning of possible or actual users. The Department of Commerce is ready to advise on standardization and simplification where the facts are not evident from an analysis. A survey will discover the volume value of any market. A study of different channels will show the best, and in different localities this may vary. There are many experts on advertising and on price making. A little money spent in expert advice frequently will make a vast future difference. There are, however, other phases of the whole marketing problem which are important to the industrial situation.

In many trades modern practice has developed trade associations, although in origin these associations are quite ancient, the Writing Paper Association having been formed some 60 years ago. The basis of these associations is that industrial units of like products have very many mutual interests. They all serve the public, and unquestionably they can serve the public

by mutual association much better than by separate and unassociated endeavor.

From the industrial unit point of view there are many advantages in association. The law permits the gathering of market data of total demand, demand by grades, etc., and this information is valuable in guiding the individual unit in rendering its share of the service. The individual unit thus gets a very clear view of the total market, its fluctuations up and down with the business cycle, and its fluctuations in price, and can better arrange its own relation to the market. The law specifically prevents the association from acting to control the market or the price, but it does not prevent it from giving the individual unit a clear view of the total situation which he is usually unable to secure for himself.

The Trade Association's Place in Expansion

A great effort of the American manufacturer is for volume sales. The industrial executive estimates, and correctly, too, that if he can keep his plant and machinery running full he will divide his expenses over the maximum product and obtain the minimum expense cost. Having arrived there, possibly, he then figures if he increases his capacity he will make a still further reduction in cost and so adds to his plant and equipment. There arrives a point, however, where in many cases this is not true, because after a certain size is passed, the necessary increase in organization may increase the expense to the detriment of cost, and particularly is this so in the retrograde of the business cycle, or, as frequently happens, if the expansion of the trade in general is greater than the growth of public demand. In these cases no unit gets normal capacity orders, prices are cut, and failures occur.

It is here that trade associations are very valuable to keep the individual units in touch with the condition of the trade, the business cycle, and the rate of growth, and the necessity or folly of plant expansion.

The Possibilities of Foreign Trade

A developing need in America, with its growing industrial expansion, its high wages, and its high standards of living is to develop foreign trade. This is a task to which our industrial executives should give more attention and study. The Department of Commerce is making a real effort in this direction and needs support. There is no question but that over the next quarter of a century there lies a great opportunity here for American manufacturers. Asia, Africa and South America, with large material resources, increasing standards of living still far below America's, and small manufacturing ability as yet, are bound to develop fine markets under a combination of financial and industrial effort. But if this is to occur happily, American industry will have to do what it has not very fully attempted to do as yet—to consider the actual needs and desires of these countries in particularity of demand, in marking, in packing, and in transportation. Undoubtedly in marketing American industry has ahead of it this great possibility.

In a consideration of the marketing question there are internal problems which the industrial executive must work out. A modern method, both from the sales and production points of view, is to budget or fix quotas for the sales at the beginning of the year period. This consists in making a careful detailed estimate of sales by lines, localities, customers or by whatever divisions seem practical. Such a budget, of course, demands some historical record behind it, combined with the best sales judgment, and it needs also a certain amount of readjustment quarterly and monthly.

Another very important matter to be considered in the matter of marketing is the inventory. It is expensive from the point of view both of investment and of fluctuating prices, either of material or finished product, to have a large inventory. On the other hand, if business is to be served promptly it is important to have a sufficient inventory on hand. Much money can be saved by a carefully planned and watched inventory.

Of course, after all is said and done, marketing consists in the main of a definite studied plan, with all the elements considered, and salesmanship, which should be merely an attempt to carry out the plan.

Salesmanship will vary in importance with each unit according to the channels of marketing. There are industrial units with only one or two salesmen. There are others with 2000 or 3000. But in all cases the industrial executive will find it valuable to see that certain essentials are found in his salesmen. There are certain qualities, personalities and abilities, the possession of which make for finer salesmanship. But with any salesman the best results depend on certain attitudes and methods of the industrial executive.

In the first place, salesmen should be trained. They should understand thoroughly the products of the industrial unit, the intricacies of their manufacture, the limitations and scope of their usability. They should know the product through its production. They should know what the unit can and cannot do. One floor-covering concern puts no man on the road unless he has had a three or four months' factory training, and calls him back once a year for further schooling and consultation. When on the road the salesman should make a daily report of his expenditure of time, and picture the situations he runs into and develops. A large insurance company finds that its men spend only $1\frac{1}{10}$ hours per day in actual sales interviews.

Salesmen should not be allowed to go out except with a definite sales plan and intention and, whenever possible, a definite sales quota. Whenever possible they should operate on an incentive plan.

Marketing a Public Service

Undoubtedly, marketing is both the final as well as the most critical of the functions of the industrial executive. On it depends his eventual success. The world is his oyster, but it is hard to open, and particularly to keep open. That which will most readily keep it open is a clear understanding on the part of the industrial executive that the public owes him and his unit nothing, but if he wants success he must render highly sensitive service. And that is the basis of industrial service.

Practical Methods of Analyzing Loss in Manufacturing Profit

Working Plans for Profits—VI

By G. CHARTER HARRISON

Consultant in Management

THE other evening my wife announced that she was contemplating bringing a suit against a certain major for alienation of affections, wherefore I reflected a bit upon the many hours I had expended in experimenting with the three more important inventions of that gifted young radio engineer and inclined to the belief that she stood a very good chance of winning her suit.

It was on the occasion of my testing out the major's 8-tube superheterodyne circuit that I received a somewhat illuminating lesson, the implications of which extended far beyond the range of radio. In constructing this "Rolls Royce of Radio" with the intention of getting the very best results possible, I had equipped my apparatus with numerous devices recommended by authorities on superheterodyne construction, among which was a grid leak capable of most delicate adjustment. For an hour or two—time being no object to the "superhet" enthusiast—I adjusted and readjusted this contraption, and as a result of these constant adjustments it ultimately became loosened and suddenly fell off, whereupon, to my great surprise, I found that the distant station to which I was tuned came in with a remarkable increase in both volume and clarity.

There is many a business which, like my radio outfit, would be very much better off if some of its superfluous frills were dropped off.[1] While it will readily be admitted that a large proportion of business concerns are lamentably in need of system, on the other hand it must also be conceded that in many businesses the enthusiastic drive for "efficiency" has swung the pendulum too far in the opposite direction, so that refinements of methods have reached a stage where the law of diminishing returns is operating to the detriment of the business.

Losses Through Refinement

In business as in other things, the quickest path is often the middle one, for as Francis Bacon wrote over 300 years ago:

> Above all things, order and distribution, and singling out of parts, is the life of dispatch, so as the distribution be not too subtile; for he that doth not divide will never enter well into business; and he that divideth too much will never come out of it clearly.

"He that divideth too much" has been very active in business and many a cost accountant reveling in refinements of expense distribution would be well advised to reflect upon Francis Bacon's warning not to make distribution "too subtile." Frederick W. Taylor himself if he were living today would, without question, achieve his results with much simpler routine methods than those which he actually used, for the methods he advocated involved a great deal of clerical work which could be avoided. Unnecessary refinements in planning, cost accounting, and stores accounting are like unnecessary refinements in manufacturing; "good enough" is *good accounting* just as surely as it is good engineering, and the manufacturer who endeavors to obtain the same accuracy in a relatively crude machine as is necessary in a finely adjusted watch is simply throwing away his money without benefiting anyone. The important problem is to determine what constitutes "good enough" under the existing conditions.

Profitable Accounting

Let me give an illustration. Some time ago I was called upon to advise a large manufacturing concern regarding its cost problems, which were exceptionally complex. One matter which had to be decided upon was the extent to which refinements were necessary in determining the cost of sales for the purpose of the monthly profit and loss accounts. Alternative methods were submitted, one of which could be safely relied upon to give accurate results within an error margin of $15,000 a year, while the other plan would furnish results accurate within a few hundred dollars. This second plan, however, would involve a cost of at least $10,000 a year more than the first. I was dealing with gentlemen with a well-developed sense of proportion, and therefore it is needless to state that the first plan was adopted, for in that particular business nothing would be gained from an increased refinement of accuracy to the extent of a few thousand dollars a year. It was in this same business, however, that I found that for years the pay-master had been spending several thousand dollars a year in re-checking the work of the pay-roll department, which was not under his supervision. He proudly showed me that on several

[1] For previous articles see MANAGEMENT AND ADMINISTRATION for October 1924, p. 361; November 1924, p. 491; December 1924, p. 605; January 1925, p. 4; and February 1925, p. 165.

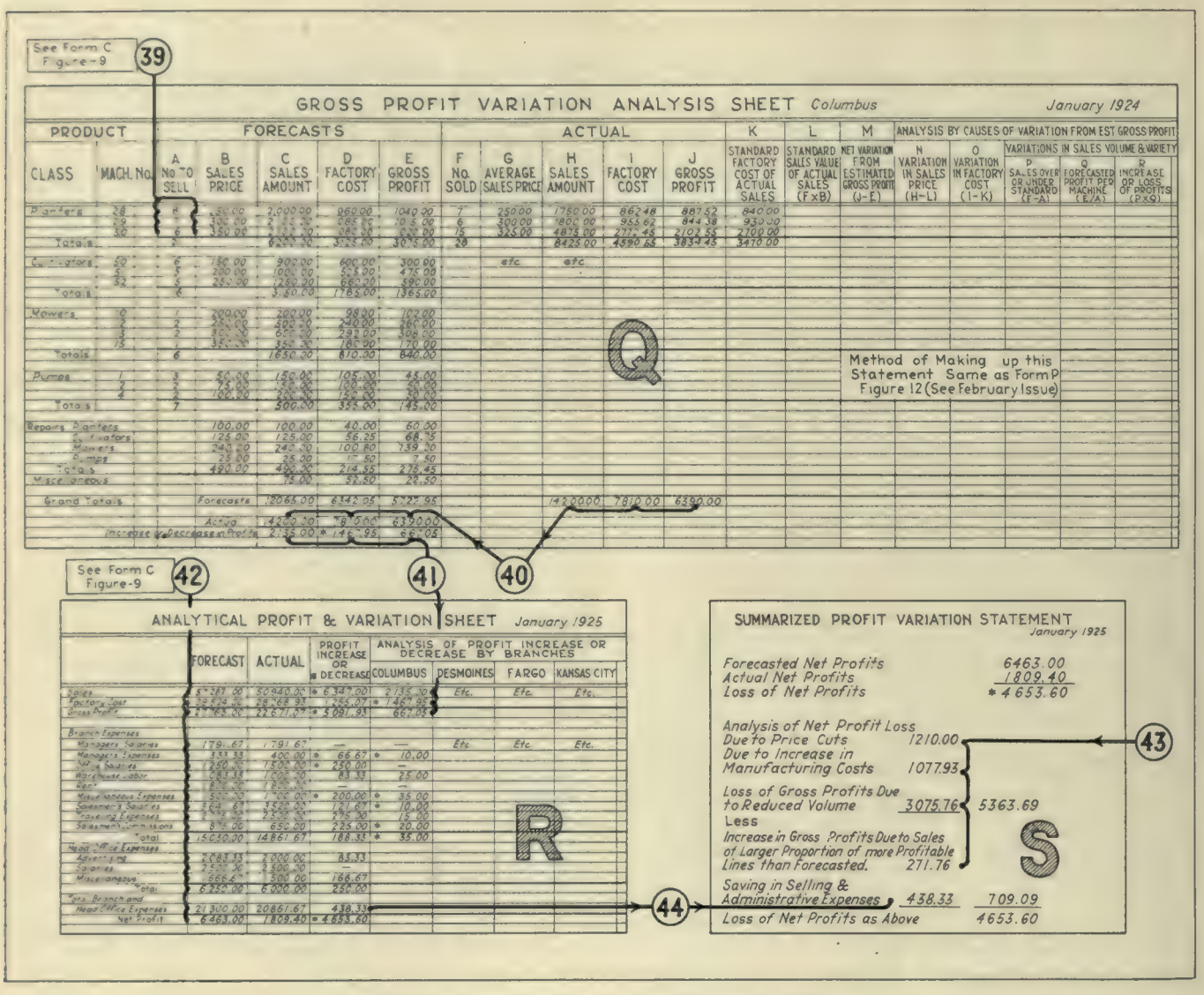


FIG. 13 ANALYSIS OF LOSS IN NET PROFITS BY CAUSES

occasions he had discovered errors in the pay-roll amounting to as much as $5 and $10 a month! Now obviously some checking on his part was a wise precaution as a safeguard against pay-roll padding, but as good a check upon fraud could have been obtained at one-fifth the expense by the adoption of a carefully formulated partial audit plan.

How do we define "good enough" as applied to the routine of a business? I would say that a method is "good enough" until some other method is available which can reasonably be expected to increase the profits of a business to a greater amount than the new method costs over the old method or which will give as good results as the old method at less cost. There was a time when I advocated planning systems under which the work was carefully planned for every machine in the shop, but I now realize that in many cases all that is necessary or desirable is to plan carefully for the "neck of the bottle" and to rely upon the foremen to take care of planning for the balance of the machines.

It is remarkable what a number of preconceived conceptions are abandoned when we apply this doctrine of "good enough" to our business methods, and what a lot of routine work, which we formerly considered absolutely essential, can be abandoned.

It is accepted as axiomatic by most accountants that stores requisitions covering issues of materials used in manufacturing processes must be priced and extended and transferred from the Raw Materials controlling account to the Materials in Process controlling account, but, as I shall endeavor to show in the illustrations to the next instalment of this series, this intermediate Materials in Process account usually can safely and profitably be eliminated and a great deal of unnecessary clerical work avoided.

Standard cost accounting, being based upon the principle of exceptions, should be the most economical form of cost accounting. But the other day I came across an interesting article on standard costs in which the writer questioned the economy of standard cost accounting except in plants where a rather limited number of standard articles are manufactured in large quantities. In view of the fact that the writer of this article admittedly based his arguments upon methods of cost accounting described and advocated by me seven years ago I felt a certain responsibility

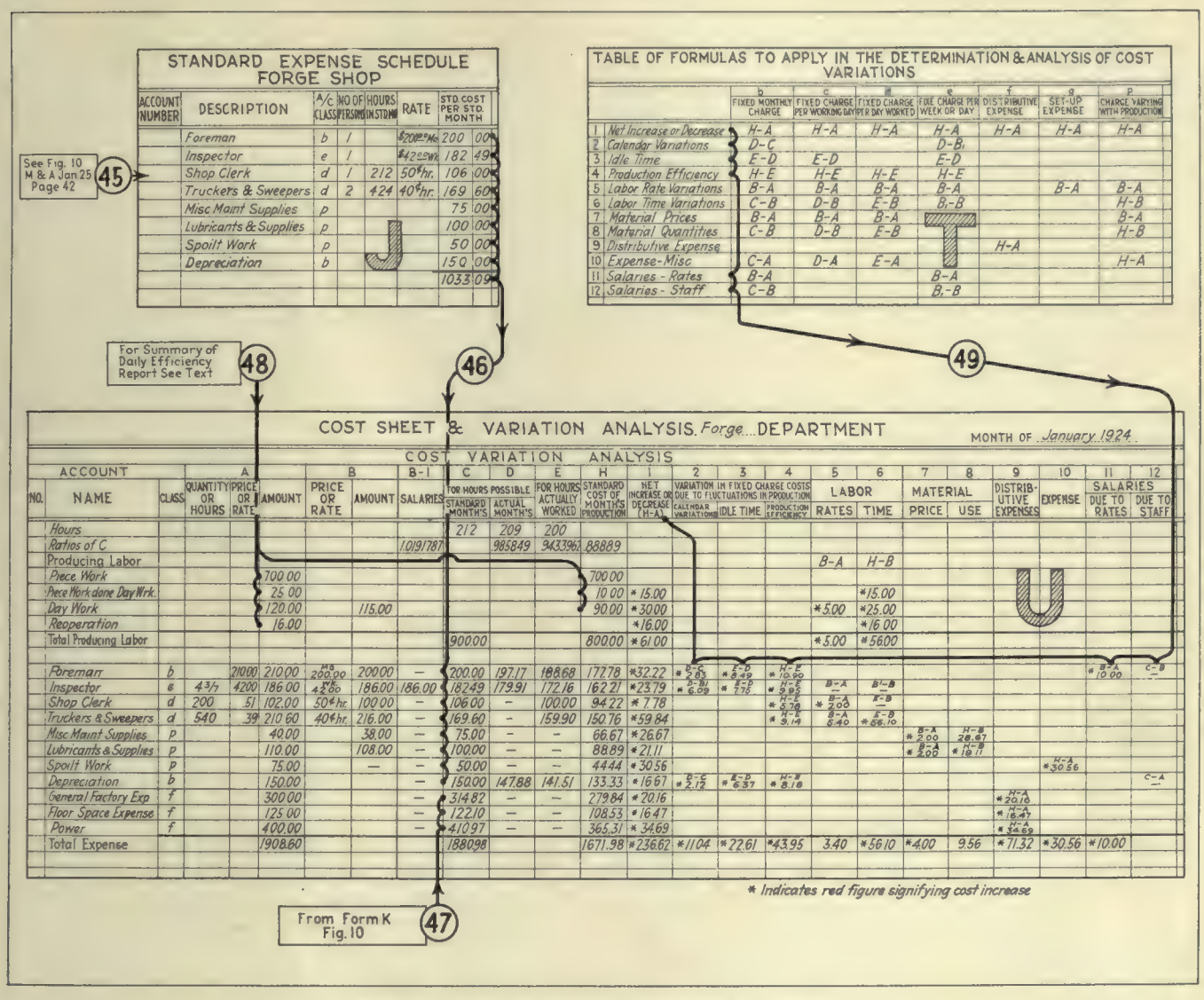

STANDARD EXPENSE SCHEDULE
FORGE SHOP
TABLE OF FORMULAS TO APPLY IN THE DETERMINATION & ANALYSIS OF COST VARIATIONS
See Fig. 10 M. & A. Jan. 25 Page 42
45
For Summary of Daily Efficiency Report See Text
48
46
49
COST SHEET & VARIATION ANALYSIS. Forge DEPARTMENT
MONTH OF January 1924
COST VARIATION ANALYSIS
* Indicates red figure signifying cost increase
From Form K Fig. 10
47

FIG. 14 ANALYSIS OF COST VARIATIONS BY CAUSES

for his views even though I did not share them. One thing he apparently overlooked was that standard cost accounting is a comparatively new art, the technique of which is being developed rapidly, and that this form of cost accounting should not, therefore, be judged by methods which were "advanced" in a double sense in 1918. Suffice it to state that standard cost accounting is, without question, the most economical method of cost accounting yet devised, which will in any way meet reasonable requirements. Of course the cost of operating a standard cost system depends very largely upon the character of the business in which it is used; and, in a plant where a great deal of special work is done, more work is required than in the ideal situation from a cost standpoint, where most of the operations are performed on a piece-work basis, and in which the cost of cost accounting can be reduced to an exceedingly low figure.

In the previous instalment of this series,[2] I illustrated a method of analyzing by causes the difference between the actual and the forecasted gross profits. In Fig. 13 I carried this analysis process a step further and illustrated the method of analyzing the difference between the forecasted and the actual net profits, this analysis being shown on the summarized profit variation sheet (Form S). I also show on Form Q the method of analyzing the variation between the forecasted and actual gross profits of an individual sales branch should it be considered desirable to introduce this refinement in analysis.

Once an analysis of variations in gross profit has been made, the process of analyzing net profit variations is an exceedingly simple matter, and Fig. 13 should make the process entirely clear. The method of arriving at the gross profit variation analysis marked as operation 43 is described in the previous instalment of this series.

Analyzing Cost Variations by Causes

The necessity for some form of mechanism for furnishing an analysis of cost variations by causes was an inevitable development of the standard cost idea. As

[2] MANAGEMENT AND ADMINISTRATION, February 1925, p. 165.

soon as the cost accountant came to the point where he was able to tell the president of the company that the actual costs were in excess of the standard, it was a foregone conclusion that the president was going to ask why. It was, I found, distinctly embarrassing not to be able to answer that question promptly and completely, and I was, therefore, under the necessity of devising some means whereby the analysis of variations from standard could be reduced to a basis of such simplicity that it could be successfully and rapidly performed by the ordinary grade of clerks in the average cost department. This result was accomplished by the introduction of the cost sheet and variation analysis sheet (Form U), which can be handled by anyone who can add, subtract, and multiply, or can operate a machine which will perform these arithmetical processes. Furthermore, in order to guard against errors in mechanical work, the sheet is made self-balancing.

Before describing the mechanism involved in the determination and analysis of variations from standard cost, let us summarize the information which Form U is designed to furnish. It will be noted that this sheet is divided into two sections, the upper section providing an analysis of the variation in producing labor costs and the lower section the variation in burden costs. As regards producing labor, it is assumed that the actual producing labor pay-roll of the forge department in the month of January was $861, whereas the standard producing labor cost of the work done was only $800, representing an increase of $61 as follows:

Increase in day rates	$5.00
Excess cost of piece work done day work	15.00
Day work inefficiency	25.00
Re-operation labor	16.00
Total increase	$61.00

The lower section of the cost sheet and variation analysis shows that the actual burden cost of the forge department was $1908.60, whereas the standard burden cost of the operations performed by this department totalled only $1671.87, an increase of $236.62. As shown by the totals of the cost variation analysis columns of the cost sheet and variation analysis this increase in costs was made up as follows:

Calendar variations	$11.04	
Idle time	22.61	
Production inefficiency	43.95	
Excess labor	56.10	
Price of supplies	4.00	
Distributive expenses	71.32	
Excess spoilt work	30.56	
Increase in salary rates	10.00	
Total increases		$249.58
Less decreases:		
Labor rates	$3.40	
Use of supplies	9.56	12.96
Net increase as above		$236.62

The basis of the calculations necessary to obtain the above analysis is the table of formulas shown on Form T, which necessitates symbols as follows:

A—indicates the actual time or materials expended, figured at the actual rates of pay or price of material.

B—indicates the actual time or material expended, figured at the standard rates of pay or the standard price of material.

B-1—indicates the standard salary for the actual weeks or fractions of weeks in the month. To obtain it the following formula is used:

$$\text{B-1} = \frac{\text{C (Standard cost for standard month)}}{\text{Number of weeks in standard month}} \times \text{Actual number of weeks in month}$$

The number of weeks in the standard month is arrived at as follows:

Days in year..... 365

Weeks in year..... $\frac{365}{7} = 52.14286$

$$\text{Weeks in standard month (1/12 of year)} = \frac{52.14286}{12} = 4.24524$$

B-1 in the different lengths of months is therefore:

For a 28-day month..$4.24524 \times 4 \times C = C \times 0.92055$
For a 30-day month..$4.24524 \times 4\,2/7 \times C = C \times 0.98630$
For a 31-day month..$4.24524 \times 4\,3/7 \times C = C \times 1.01918$

C—indicates the standard cost for the standard month, which in this series of articles has been taken as representing 212 working hours.[3]

D—indicates the standard cost for the number of standard working hours in the month. For instance, according to the table of standard working hours in standard month, the standard number of working hours in January is 209, so that in this month, D will equal $\frac{209}{212}$ of C.

E—indicates the standard cost for the actual hours worked in the month. According to the cost sheet and variation analysis (see Form U), the forge department worked only 200 hours in the month of January and, therefore, in this case, E represents $\frac{200}{212}$ of C.

H—indicates the standard cost of the actual production for the month.

(To be concluded in the April issue.)

[3] See MANAGEMENT AND ADMINISTRATION, January 1925, p. 45, table of standard working hours.

Alvan T. Simonds Economic Prizes

TWO prizes of $1000 and $500 are offered by Alvan T. Simonds, President of the Simonds Saw and Steel Company, for the best two essays on the following subject: "Your Prosperity and Mine," written by residents of the United States or Canada. The essays may be entirely original, or based on books or articles, references being given in footnotes; must be 2500 to 3500 words in length; typewritten on one side of the paper. The judges' decision must be accepted as final. The prize winning essays will become the property of Mr. Simonds.

The essays must reach the Contest Editor, Simonds Saw and Steel Company, 470 Main Street, Fitchburg, Massachusetts, on or before December 31, 1925.

Enter Order—When Will You Ship?

Lodge and Shipley Methods for Controlling Production—II

By H. S. RIGGS

Advertising Manager, the Lodge and Shipley Machine Tool Company

IN a previous issue[1] we presented a general picture of the method of procedure by means of which The Lodge and Shipley Machine Tool Company is able to give a definite and reliable answer to the question "Enter order—when will you ship?" In this article the more important features of the control systems will be described in detail. We will trace the entire course of an order through the shop from the time it is received until it is shipped complete.

When an order for a lathe is received, the sales office marks on it the number of the next run of the size lathe specified that is coming through the shop and assigns a machine serial number to it. It is assigned a delivery date, and an order clerk then writes up an order sheet, making five carbons. Another copy of the order, known as the "hard copy," is typewritten on heavy paper, using a copy ribbon. The order sheet is indexed and filed under the order number in a loose-leaf order book. One copy of the order is retained by the sales department; three copies are sent to the engineering department; one tissue, together with the "hard copy," is sent to the works office.

[1] See MANAGEMENT AND ADMINISTRATION, December 1924, p. 643.

ORDER NO.	DRAWING ROOM	MACH. NO. 27602	
SIZE MACH. D18 X 10		RUN NO. 236	
BED ★	LEAD SCREW ★	DOUBLE FRIC. C S @	TAPER ATT. @
QUAD. & CHG. GRS. ★	LD. SCR. HD. BOX ★	CONE HD. @ 3	TAPER TEL. SCR. @
SLID. TUMBLER ★	STEADY REST ★	SHOULDER STOP (CONE)	METRIC. TRANS. GRS.
CARRIAGE ★	SEL. HEAD	SH. ST. BAR	DRAW CHUCK
CROSS FD. SCR. ★ OMIT	BRAKE PULLEY	DIAM. STOP	NO. 1 SET LD. SCR. SUP.
TAILSTOCK ★	REV. PULLEY	DIAM. STOP MIC. COL.	NO. 2 SET LD. SCR. SUP.
APRON ★	FRIC. CONT.	TOOL POST 1	END LEGS STD. @
GEAR PLATE ★	FRIC. CONT. & S. S.	4-WAY TOOL BLOCK	MIDDLE LEGS 1
COMP. REST ★	CONTROL ROD	HI. DUTY TOOL BLOCK	PAN AND END LEG
THD. INDICATOR ★	BELT. MOTOR DRIVE	CONN. REAR REST	PUMP EQUIPMENT
FIT TWO CHUCK PLATES ONLY.			
NOT MOUNTED	H.P.		

FIG 6 ERECTION TAG

Made out in quadruplicate and fastened together by perforated tab not shown in illustration.

Works Office Routine

If the particular run out of which the order is taken is under construction, a dozen or so copies are made of the "hard copy" on a duplicating machine. These are sent out to all the shop foremen concerned; the engineering department; the tracers; the sales office and the works office. In other words, all who have anything to do with getting the lathe out, receive a copy of the order. An order analysis sheet is kept for each run of lathes. As each lathe is reserved, a record of it is kept and the number still available is noted. This prevents overselling any particular run.

Engineering Department Routine

When the engineering department receives a copy of the order it issues a floor erection sheet. These erection sheets are issued under a run number and show the quantity of each assembly required to erect the entire run of lathes. In addition to assemblies, the sheets also cover all parts required in erection which are not part of any assembly. They also contain information about such things sent in for application to the lathe as chucks, motors, etc. Customers' parts slips are made out to keep account of these things. Four copies of the floor erection sheets are made up. They are distributed as follows: One set goes to the erection foreman; one set goes to the cost department; one set goes to the stock control desk where the necessary requisitions are made out and a final check made of the control work to see that everything is ordered; one set goes to the final inspector who uses it to check up any discrepancies that may be discovered while inspecting the lathe.

The requisitions made up at the stock control desk are sent to the stockkeeper to get out the necessary assemblies and parts. With this material, the erection foreman builds the lathes as specified on the erection tag. If any parts required are not in stock, a green shortage sheet is sent to the erection department and filed in the rack. While the shortage book really does the "pushing," the green slips do the "pull-

ing" of the parts through the shop. This serves as a constant moving power behind all material in process.

The Erection Tag (Fig. 6) is made up in the engineering department and one is issued for each lathe. Three carbons are made of each tag. On the tag is the machine number, the size and style head, the run number, the length of bed, the date; and every unit wanted on the lathe is starred. As the lathe is built the stamping number of each assembly is written on the tag by the erection foreman. The original copy is retained by the engineering department. The carbons are distributed as follows: One goes to the cost department for keeping a record of the cost; one is returned to the engineering department with the stamping numbers of each unit used filled in; and one is fastened to and is shipped with the lathe.

The engineering department sends the erection tags to the head tracer, who makes out a duplicate of each in large chalk letters on a blackboard. This is hung up in the erection department with the tag wired to it so that all who do the actual erecting can easily see just what goes on each lathe. When each lathe is erected the board is taken down and the tag is wired to a handle on the machine.

The Control Board

The control board is literally the heart of the whole system. Its function is to start the work through the shop. Based on the theory that "well begun is half done" this board is indispensable. It is large enough so that all of the runs being worked on can be laid out into their various units and sub-assemblies. The board is 4 x 12 ft., is hung on pulleys and counterbalanced so that it can easily be raised or lowered. A paper record is tacked on in sections. This record is made up as shown in Fig. 7. A traveling guide can be run back and forth along the board to assist in following the lines.

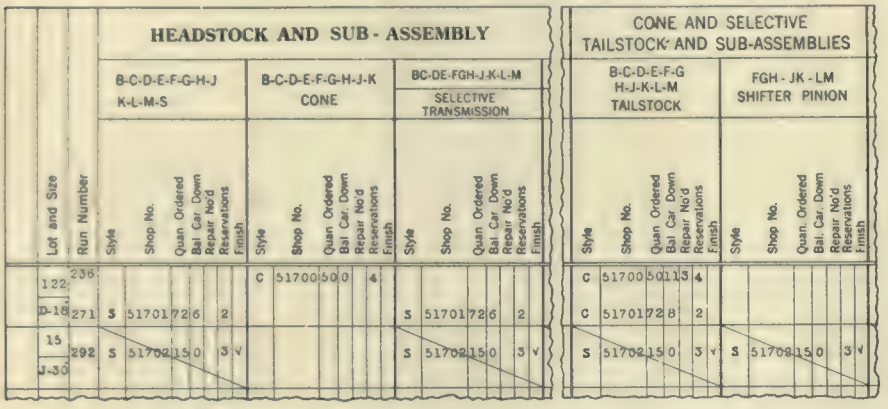


FIG. 7 DETAIL OF SHEETS USED ON THE CONTROL BOARD

The use of the control board has many advantages. The various runs can be checked over in about one-third the time that it would take in going over cards; complete information is readily accessible to all who are concerned; there is no time lost hunting for lost or misfiled cards; previous lots can be looked at for comparison; reservations can be made more quickly and low limits more easily watched. When assembly time on any particular lot is compiled by the cost department the card is checked against that lot on the master board. This aids greatly in estimating deliveries.

On the left end of the board are two columns for such information as the size of the lathe, the quantity, and the run number. In the first column shown in Fig. 7 will be noted "122 over D-18". This indicates that a run of 122 lathes of 18-in. size are to be put through consisting of 50 Cone Head Lathes and 72 Selective Head. With the exception of the headstocks, both styles of lathes can be put through as one lot and for convenience they are always laid out in adjacent runs.

For each unit and sub-assembly there is a separate column for the following information: Style; Shop Number; Quantity Ordered; Balance Carried Down, or the number of parts on hand from a previous lot; Repair Number, or how many of that part are wanted for repair orders; Reservations, or how many sold; and Finish, or how many actually are finished, allow-

SYMBOL OF OTHER MACHINES USED ON GD18 — ASSEMBLY DR. 21521-C

SYMBOL	MACHINE	AMOUNT	SHOP NO.	RUN NO.	
D	18" Lathe				CASTING SHEET 1
	UNIT Tailstock	50	51700	236	CUT-OFF SHEET 1
					STOCK SHEET 1

ELEMENT SHOP NO.	PIECE NO.	ELEM. QUAN.	DRW. SIZE	CASTINGS	QUA	MAT.	DIA.	LENGTH	NOTES
71828	D985	50	B	12599 Base	1	C1			
71829	C981	56	A	16296 Binder Lever	1	DF			
71830	D1001	56		20323 Back Binder Jaw	1	C1			
71831	D1002	56		20322 Front Binder Jaw	1	C1			
71832	D-1829-1	56	B	11277 Handwheel	1	C1			
71833	51796	50	C	TOP	1	C1			USE CST 33283
71834	51797	56		PLUG	1	C1			USE CST D983
				ERECTION DETAILS					
71835	D994	56		11278 Clamp	2	C1			
71836	D987	56		11279 Wrench	1	SC			

ISSUE ON SHOP NO.	REQUIRES PIECE	SELECT FOR EACH MACHINE
USED ON SHOP NO.	43078-182-3) (48601-205) (50406-209) (53047-216-7)	
STAMPING NO.	27521	
USED ON SHOP NO. (56735-229) (59408-236) (71959-262-4)		
STAMPING NO.		

CHECKED TR. CH.

Stamping #24461 has been issued on obsolete parts list. A. Binder 4-19-20

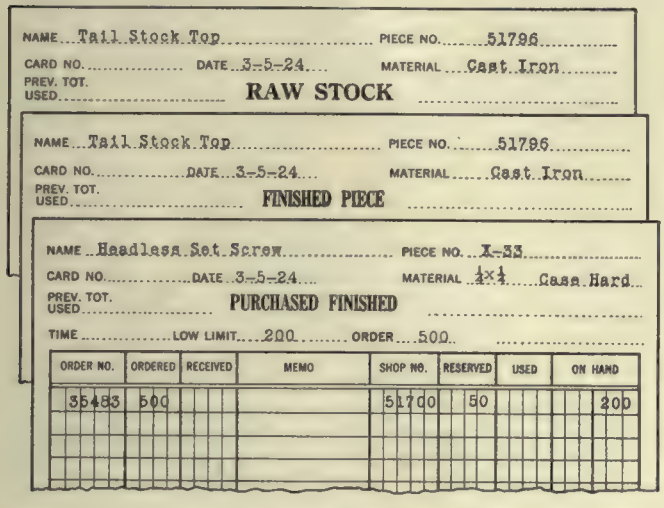
FIG. 8 ASSEMBLY PARTS LIST

One sheet each is used for castings, cut-off stock, and finished parts. All are enclosed in an envelope containing essential order information on its face.

ing for defective material, spoilage, and waste.

Three horizontal spaces are allowed at a time for each size. When any particular run is finished a check is marked in the Finish column and a diagonal line is drawn across the column for that unit, as indicated. This shows at a glance just what runs have been finished.

On the left in Fig. 7 is shown the Headstock and Sub-Assemblies only. This same layout, however, applies to each unit. Directly beneath the name of the unit are the letters B C D E F G H J K L M S. These letters indicate the size of machine. Under the


NAME Tail Stock Top PIECE NO. 51796
CARD NO. DATE 3-5-24 MATERIAL Cast Iron
PREV. TOT. USED
RAW STOCK

NAME Tail Stock Top PIECE NO. 51796
CARD NO. DATE 3-5-24 MATERIAL Cast Iron
PREV. TOT. USED
FINISHED PIECE

NAME Headless Set Screw PIECE NO. X-33
CARD NO. DATE 3-5-24 MATERIAL ¼×¼ Case Hard
PREV. TOT. USED
PURCHASED FINISHED
TIME LOW LIMIT 200 ORDER 500

ORDER NO.	ORDERED	RECEIVED	MEMO	SHOP NO.	RESERVED	USED	ON HAND
35483	500			51700	50		200

FIG. 9 STOCK CONTROL CARDS
Colors are used to distinguish the three classes of stock.

columns headed Selective Transmission and some of the others, the letters are grouped—BC DE FGH, etc. This indicates that these sizes are common and that two or three lots can be brought through the shop at one time. This, of course, means a great saving in manufacturing cost per unit. The spacing of each division permits them to be separated into quantity, shop number, and a space for checking.

In order to determine the quantity required the following method is used: The units are divided into three groups:

1. For units that compose the *standard lathe* such things are considered as:
   - Quantity on hand
   - Quantity needed
   - Additional units required for repair orders (This is estimated from previous sales.)
   - Quantity that may be found defective or spoiled before completion.
   - Quantity that is identical with another size which will be brought through in a short time. These are then combined into one lot.
2. *Standard attachments* manufactured for stock are made in lots sufficiently large to secure the most economical production. When a set low limit for any attachments in stock has been reached a new lot is started through. If it is estimated that the quantity in stock will be used up on the lot of lathes under construction, bringing the stock below the low limit, a new lot of units is brought through with the lathes.
3. Such *attachments* as are *special* are handled in two ways. Some are ordered out only after they are actually sold. Of those that are more frequently ordered, the quantity needed is estimated and this is made up with the units of the lathe.

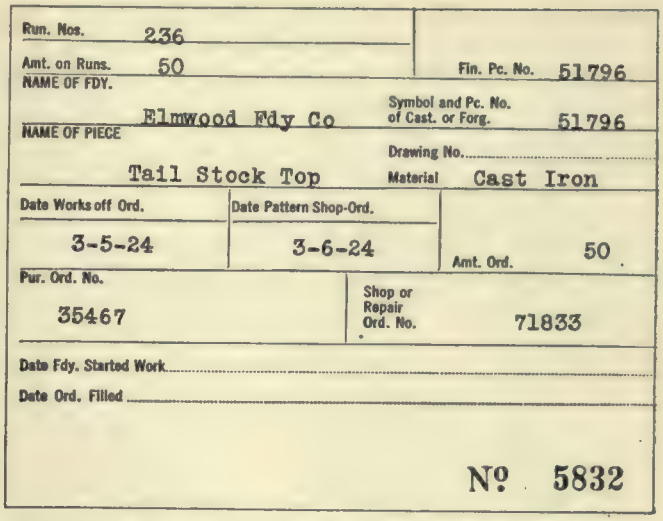

Run. Nos. 236
Amt. on Runs. 50
NAME OF FDY. Elmwood Fdy Co
Fin. Pc. No. 51796
NAME OF PIECE Tail Stock Top
Symbol and Pc. No. of Cast. or Forg. 51796
Drawing No.
Material Cast Iron
Date Works off Ord. 3-5-24
Date Pattern Shop-Ord. 3-6-24
Amt. Ord. 50
Pur. Ord. No. 35467
Shop or Repair Ord. No. 71833
Date Fdy. Started Work
Date Ord. Filled
No. 5832

FIG. 10 FOUNDRY TRACER SHORTAGE SLIP
Used to check up receipt of raw materials.

After taking these items into consideration the shop order department enters on the board the quantity to be brought through. Lathe reservations are made across the board under each of the units that compose the lathe. At the same time a unit card or assembly tracer is filled out. The board reservations are posted from a request for order card, which is then filed as a permanent record.

The Parts List

The parts list is made up by the engineering department when they receive the unit card or assembly

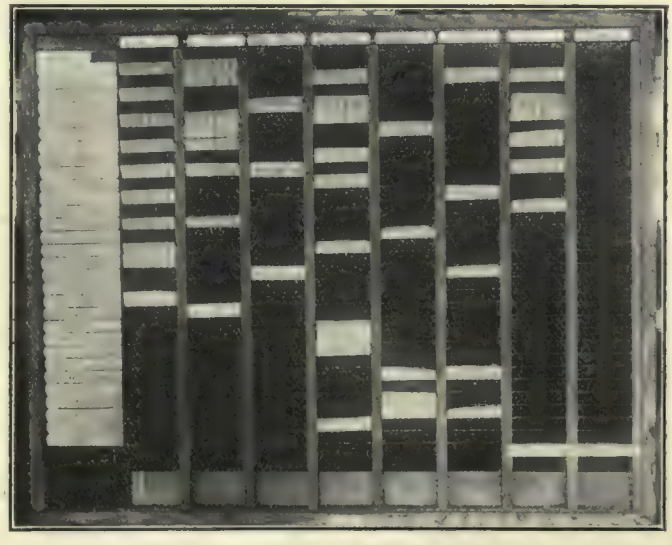


FIG. 11 ASSEMBLY SHORTAGE BOARD
Where shortage slips are filed.

tracer calling for the number of units required. The Parts List is shown in Fig. 8. All of the parts necessary to construct the unit are shown on it, including a detailed blue-print of the job. Parts made from bar steel or cut-off stock; parts made from castings; parts purchased finished and to be held in stock until called for, are written up on separate sheets.

At the top of the parts list the number of units required is shown. Under the column headed by "Elem. Quan." is given the number of each of the parts necessary to assemble the quantity of units

OPERATION	DD-2 Plane compl T1# 16478						SHOP NO.	71833			
							SYM. & PC. NO.	51796			
NAME OF PIECE	Tlstk Top						QUAN.	50			
TRACER CHECK	PREMIUM PAID		SCRAPPED		DETACH		TO COME				
HELPER OR CONTINUATION STAMP					PRIOR C'S'M'D TIME		DAY	OFF TIME	OVER TIME		
					MAN NO.	TIME					
MAN NO.	WORKMAN						THUR.				
							FRI.				
			STOP				SAT.				
			START				MON.				
ALLOW PER PC	TOTAL ALLOW	O. T.	RATE	EARNINGS			TUES.				
0.75							WED.				
TOTAL CONSUMED TIME					NOTES						
PREMIUM											
					FINISHED OR NOT FINISHED STAMP						
657											

FIG. 12 TIME TICKETS

Stamped by time clerks and used by cost department in determining costs.

specified. Under the Quan. column is given the number of parts required to assemble one unit. These parts lists are made out in triplicate and are sent out as follows:

1. *Works Office Copy.* This is retained in the files of the works office. All of the reservations made on the Reservation Copy are entered on it. It eventually is used by the cost department for checking up the costs and also is kept as a permanent record of costs.
2. *Reservation Copy.* This is sent to the stock control or perpetual inventory desk. Reservations for all the parts called for are posted over the purchased finished, finished, and raw material cards (Fig. 9). Orders for the erection parts and castings are given to the purchasing department. They, in turn, place orders with the foundry. The Foundry Tracer Shortage (Fig. 10) is then sent out.
3. *Shop Copy.* This is sent to the works office and stock requisitions are written out for all the parts called for. The requisitions are put into an envelope and sent to the stockkeeper. He fills the requisitions and sends the parts and assemblies to the assembly foreman. As previously stated, if parts called for are not in stock the stockkeeper makes out green shortage slips and sends them to the assembly foreman so that he can check back on the shortage. These shortage slips are filed in a rack for the purpose (Fig. 11) until the parts are received. They are then taken out and destroyed. The works office regulates the sending of these parts lists and requisitions to the stockkeeper. They keep check on the work the assembly department is doing and send parts and assemblies to it as needed.

FILL THIS FORM IN DUPLICATE

INSPECTOR'S SCRAP ORDER

MAKE FOR 51700 — SHOP NO. 71833 DET. FF — SYM. & PIECE NO. 51796

NAME Tailstock top — QUANTITY ON ORDER 50 — QUANTITY SCRAPPED 3

ASSEMBLY NAME Tailstock — MATERIAL Cast iron

SCRAPPED BECAUSE defective — DUE TO blowholes (If cut off give dimensions)

BY CHECK NO. foundry — DEPT. — DATE 4-11-24

SIGNED Martin — OPER WHEN SCRAPPED FF-11

DO NOT WRITE BELOW THIS LINE IN SHOP

REPLACE				HOURS	WAGE
BY TRADE AT STOCKROOM	ON SAME SHOP NO.	BY RAISING SHOP NO.	NOT REPLACED		BURDEN
					MATERIAL
					TOTAL

FIG. 13 INSPECTOR'S SCRAP ORDER

INSPECTION CARD

Name Tailstock

Shop No. 51700

Stamp or Piece No. 27521

Size D-18"

Quan. 50

Inspected

Remarks

FIG. 14 IDENTIFICATION CARD

Placed on completed units by inspector. Duplicate notifies stock control desk job is complete.

The Stock Control or Perpetual Inventory Desk

This desk is located in the works office. It is the means of keeping a perpetual inventory and of always having the correct supply of parts on hand. All material brought to the shop is recorded and reported to the desk daily by the receiving office. Likewise, a daily report is made by the stockkeeper of all material that is manufactured and received into stock. This information is entered on the finished material cards. When any parts or assemblies are taken from stock, requisitions must be written for them and these are sent to the perpetual inventory desk. Occasionally physical inventory is taken and the accuracy of the records is verified.

The stock control desk is a tub desk and contains boxes of cards. On the top of the desk are bridges about 2 ft. wide that slide back and forth, which provide room for posting, for pen and ink, etc. Fig. 9 shows the style of card used at this desk. The cards are in three different colors: The white cards represent finished stock; the salmon, purchased finished; and the buff, raw stock. These cards show the quan-

tities reserved, used, on hand, ordered and received. The quantity available can be determined by subtracting the amount reserved from the amount on hand. Whenever the occasion demands it, complete information can be secured from these cards.

To be certain of having the necessary pieces in stock a reservation is made as soon as it is known that the parts will be needed. This prevents having to hold up work after the assembly has begun. When the last time ticket is received on a unit, the tracer card is removed from the file and sent to the shop order desk, where it is noted in the shop order book as completed, together with a note as to the number ordered and the number finished. This information is also posted to the control board. The tracer card is then sent to the cost department notifying them that the lot or run under that number is completed.

The Shop "Tickler"

The shop "tickler" is a simple and direct means of keeping work moving through the shop in the proper sequence. Over each foreman's desk is a rack with a number of wire clamps. When the time tickets are turned in from one department, indicating that their work on that particular job is finished, the works office looks up the file copy of the master tracer on that job. The time is posted opposite the operation just completed; a little metal flag is moved back to the left-hand side of the card. A posting clerk whose duty it is to write up the "shop ticklers" then sends a "tickler" to the foreman of the department next specified on the tracer card and moves the flag over to that operation. Fig. 5[2] shows the shop tickler. On this is written the large date, which is the date the job is sent to that department. The quantity, run number and piece number are also written on it.

The foreman puts these ticklers in the rack over his desk. It is obvious that with the date of issue of each job stamped in large letters continually in front of him he will exert his best efforts to get rid of all the older dates. A tracer makes a check-up on these every morning. If the job has not been completed he marks a little circle in red in his master tracer book after that operation. He asks the foreman the reason why it has not moved, and may be told that it is held for tools or for jigs or perhaps the job has not yet been sent from the inspection department.

If the foreman has no real excuse for not having the job done he gives the tracer a delivery on it. This is marked in the book. The works manager checks over this book every day so that he knows just where all of the material is and how it is coming along. If a job has been in a department longer than it should without any excuse and the delivery promise on it has not been lived up to, the works manager takes the situation into his own hands. He reminds the foreman that no more excuses will be taken and that the job is to be done—and done it is! In the majority of cases, however, such measures are not necessary, as the foremen appreciate their responsibility in getting the work out as promptly as possible in the sequence in which it is issued. As each job is completed the tickler is removed from the rack and destroyed. Thus the foreman can see at a glance just what work is in his department and can lay his plans accordingly.

Throughout the shop are booths in which time clerks take care of timing all jobs. An operator presents the traveler tag to the time clerk, who stamps the time on the time ticket which he has on file for that job (Fig. 12). When work on the lot of parts is finished the operator again presents the traveler tag and the time on the job is then rung "out".

"Move Stations"

To facilitate the flow of work through the shop, regular stations are marked off in each department for all material which that department has just received or is finished with. Any material found in the move station is to be taken first to the inspection department and then to the next department as specified on the traveler tag that accompanies the job. As soon as a foreman places any work in the move station his responsibility for it ceases. It is then up to the trucking system to see that it is moved promptly.

Before the next operation is done the material is taken to an inspection department and all of the work carefully inspected. The traveler tag is punched by the inspector opposite the work just inspected. The job is then set in the move station of the inspection department and taken to the receiving station of the next department specified. In this manner it can be seen how the arteries of work are kept open at all times and a supply of work always kept on hand in each department.

Inspection

It is commonly said that a shop is as good as its inspection system. Men who are thoroughly trained in all phases of lathe construction have charge of the Lodge and Shipley inspection. Great consideration is given to the interchangeability of parts—jigs and dies being used whenever possible. The foreman inspects the first piece of each lot before further work is done. This is to insure a correct start.

The work of inspectors is not so much to find spoiled work as it is to prevent it. After each operation, the lot of work is sent to a central inspection department and each piece inspected. In the event that spoiled work is discovered, the inspector makes out a Scrap Order (Fig. 13). This order states the quantity spoiled, how spoiled and also has space for any suggestions as to design or set-up of the piece to prevent spoiling any future lots.

After the assembly department has assembled a unit it is again inspected before being sent to the stockroom. Inspectors' tags (Fig. 14) in duplicate are attached to each unit and when the stockkeeper receives them he tears off the duplicate and sends it to the stock control desk. This notifies them that the unit is finished and in stock. The parts list is then sent to the stock control desk to cancel all reservations. From there it goes to the cost department as a notice to close up all records.

[2] See MANAGEMENT AND ADMINISTRATION, December 1924, p. 643.

New Type of Motor Bus

A NEW type of motor bus has been developed by General Electric Company and Yellow Coach Manufacturing Company for the Philadelphia Rapid

FIG. 1 GAS-ELECTRIC MOTOR BUS

Transit Company which, after exhaustive tests, has proved to be so satisfactory that an order for 200 has been placed for use in and about Philadelphia.

The unique feature of the new design is the power equipment. Primary power is supplied by a 6-cylinder gas engine having 4-in. bore, 6-in. stroke, and developing 60 hp. The clutch and change gear transmission ordinarily used are replaced by a generator and exciter direct-connected to the engine crankshaft, and two electric motors connected to the rear axle.

For testing purpose a double-deck type bus with a seating capacity of 67 was built and placed in service in Philadelphia during August 1924. Since that time it has been used daily, averaging 150 miles each day. From data obtained during this period, a number of facts have been discovered which tend to show that the gas-electric drive has several advantages over ordinary drives.

The gas-electric bus consumed somewhat less fuel than other types and, in addition, had the advantage, especially important when operating in crowded city streets, of a considerably higher rate of acceleration and schedule speed. A most important point developed during the tests was the fact that the engine of the gas-electric bus makes about 20 per cent fewer revolutions when running under city conditions than does the engine of a bus equipped with mechanical drive. This is because it is impossible for the driver to race the engine of the gas-electric bus and it is difficult to stall.

The electric drive is silent in operation and the customary jerks and clashing of gears at starting time are entirely eliminated. This not only adds to the comfort of the passengers but reduces the likelihood of accidents. It has been found that a person can stand without difficulty in the aisle of a bus equipped with the gas and electric drive at the time the bus is started or accelerated, or when brought to a stop.

The two-motor drive eliminates the usual mechanical differential and thus prevents skidding on slippery roads. For these reasons and also because of the constant torque of the electric motors, the wear and tear on all moving parts as well as on the running frame and body are greatly reduced, considerably increasing the useful life of the equipment.

Acceleration and all speed changes are obtained solely by manipulation of the engine throttle by means of the usual accelerator pedal. As the engine speed is increased, the generator voltage rises and the bus speed is directly affected. The bus operator need never remove his hands from the steering wheel except to apply the emergency brake. No electrical controller

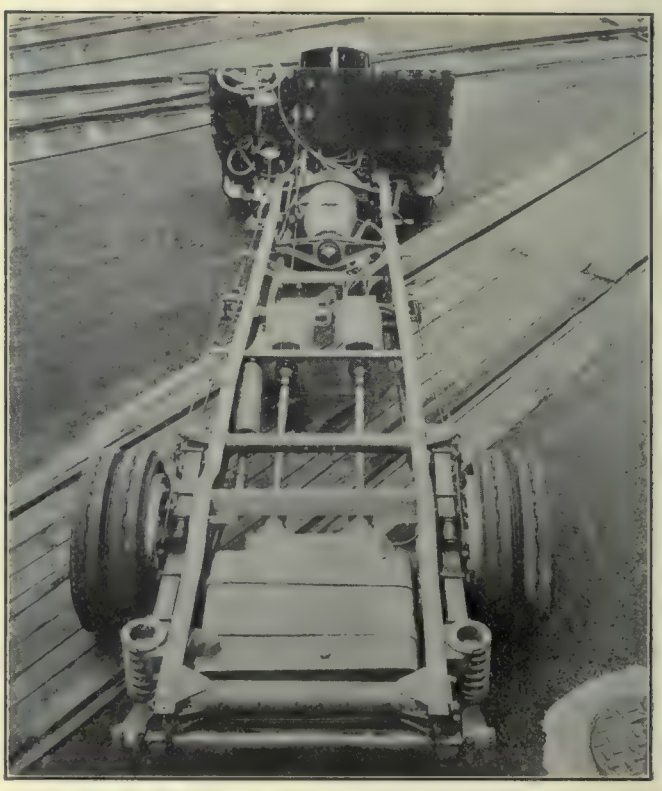


FIG. 2 CHASSIS AND POWER PLANT OF BUS

is required for the motors, nor are any electrical adjustments made by the driver when running the bus. A small switch is provided with an off position and reverse for backing.

Electrical equipment consists of a G. E., compound wound generator, with a differential series field. The shunt winding is excited by a small generator which forms part of the main generator. The output is substantially constant for a given throttle opening under all road conditions so that necessary torque for acceleration and hill climbing is provided without overloading the engine and with a smooth change of speed. Two G. E. 20-hp. motors transmit power to the rear axle through propellor shafts.

Let Your Workmen Think—It Pays!

A Suggestion System That Stimulates Ideas

By W. E. ONION

Secretary of Suggestion Committee, Schenectady Works, General Electric Company

BASING their action on the conviction that the man on the job is the logical man to suggest improved methods for doing his work, officials of the General Electric Company some time ago decided to stimulate employees' interest in their work by making it financially worth while for them to devise better and more rapid ways of performing their tasks.

Past experience had proved beyond all doubt that the man at the bench or on the machine often had practical ideas as to ways of speeding up his production without sacrificing quality. Many men, however, hid their light under the proverbial bushel, for, although the possible value of suggestions was to some extent realized, the company had failed to provide an incentive which would regularly bring these ideas to the proper authorities. It is now five years since the needed stimulus was furnished—in the form of the Suggestion Committee, which insures a careful investigation of all employees' suggestions, and the payment of a cash award for all accepted methods and ideas.

Figures taken from the report of the Schenectady Works Suggestion Committee furnish indisputable proof of the success of the system. The figures show that in 1923 the committee received and reviewed 4850 suggestions. Of this number, 908 were accepted. For these the successful suggestors received a total of $15,095 in awards.

Figures for the first six months of 1924 show that the popularity of the plan is increasing. In these six months 2531 suggestions were received from an average of 19,000 employees—equivalent to about one from each eight employees. In addition, it is noteworthy that 30 per cent were accepted, whereas but 21.7 per cent stood the test during 1923.

Reasons for Success

What accounts for the immediate and practically unprecedented success of this plan? Undoubtedly, the conviction on the part of employees that the system assures them a square deal; a realization that here was a sincere attempt to assure the worker that the practicability of his suggestion would be thoroughly investigated and that, should it be adopted, he would benefit by it in direct proportion as the company benefited. The plan was laid before the workers in detail, and it was but a short time before it was generally accepted and the Suggestion Committee was kept increasingly busy.

The purposes underlying the formation of the Suggestion Committee are to relieve the management of the routine and investigation work, to insure fair and satisfactory treatment for each suggestion, and to represent both the company and the suggestor. To accomplish these purposes, the system functions in the following manner:

Suggestions are received both through suggestion boxes (Fig. 1) located in convenient places in various buildings, and through the internal mail. Typewritten copies are made of each suggestion. These are numbered and the copies, with sketches or other necessary explanatory material, are referred to the designing engineers or persons interested.

Each suggestion is acknowledged in writing by the committee. This consists of an active staff of three men, with sufficient clerical help. It handles more than

FIG. 1 SUGGESTION BOXES

100 suggestions per week. The general committee, which includes the head of the testing department, the supervisor of mechanical research, an expert on insulation, a general foreman, and the secretary, meets once a week.

Progress of a Suggestion

To see how the system functions it is necessary to trace a suggestion through, seeing where the pitfalls lie and how they are avoided.

Let us assume that an employee has an idea regarding a process of brazing aluminum with a flux he has developed. A flux which will really do this work is needed. Before it is adopted it must receive the O K of the specialist in that line. The committee must present this suggestion to the research men and experts in the laboratories or shops.

The problem presented is that of determining the practicability of the suggestion. Several questions present themselves immediately. Does the brazing of aluminum with this flux change the physical properties

of the metal? Are its electrical properties changed? Will the braze corrode? How much will it cost? Is the process too expensive to warrant its general adoption, etc.?

It is the business of the Suggestion Committee to determine what questions the suggestion raises and to ferret out the answers. It must then act upon them in such a manner as to represent fairly the company's interest, to compensate the suggestor and to stimulate him to make further suggestions.

That the questions arising may be properly answered, the suggestion is sent to the man or men in the organization best qualified to solve the problems involved. Suppose the foreman in charge of the brazing section is consulted and replies: "I've already tried that compound. We knew about it before this suggestion was made, and we're going to use it." He is required to prove prior inception of the idea, and the steps taken to put it into effect. Should he do so, the facts are *written* to the suggestor.

If the suggestion is refused, an understandable and good reason must be given. Should the foreman of the brazing section be in error, and the suggestion is accepted, the suggestor receives an award.

Results From Plan

Improvements that might otherwise die short of fulfilment are accomplished by working through the Suggestion Committee. An important function of the secretary and his staff is to follow through adopted ideas and see that they are utilized not only in the Schenectady Works but in all plants of the General Electric Company where such improvements are applicable.

One group of girls wanted a larger restroom. The matter was taken up with the foreman, but they were unsuccessful in making him remember "to see about it." They wrote the Suggestion Committee and obtained the restroom.

It has been our experience that the more publicity we obtain on suggestions and suggestors within our organization, the more are men and women stimulated to think. With this in mind, the plant publications make a page feature in each issue, naming the awards, and giving a brief description of the suggestion.

After the award has been decided upon, the suggestor is asked to come to the next regular meeting of the committee, at which time the matter is discussed with him and he is informed of the amount of the award. Interviewing the suggestor provides a final opportunity for clearing up any confusion as to the nature of the idea.

The highest award yet made to a General Electric employee for a suggestion was recently paid Samuel Willis, an employee of the wire and cable department at Schenectady, amounting to $1000. This followed a suggestion resulting in an improvement in making paper insulated cable.

There can be no doubt about the success of the system and its effectiveness in stimulating the worker's interest in his job, and in improvements applicable to other jobs as well. Suggestions do not necessarily deal with the man's own work; anything that will advance the company's interests, or improve working conditions, is a subject for a suggestion and the company is not only willing, but anxious, to pay for those which can be adopted. This policy has proved advantageous to both the company and the employees.

Equipment for Cleaning the Shop Floor

A NOVEL assembly of equipment for keeping the shop floor clean is shown in Fig. 1. There is nothing new about the individual items making up this outfit, for they consist of the conventional broom, buckets, shovel, and truck on wheels which permit of turning sharp corners quickly and easily.

But the construction of the truck, with its purposely inclined front end, and the conditions surrounding its use, make it a useful model to pattern after.

This picture was taken in the Don Lee automobile sales and service building in San Francisco. In this plant a small crew of janitors is busily engaged all during working hours in keeping the floors swept and the place clean.

The protection and cleanliness achieved are not entirely net expenses. On each floor there is an opening to a large chute leading to the basement. When a janitor has filled his truck with sweepings, he wheels it over to this chute, opens the slide, and dumps the contents down the hole. They fall into the hopper in the basement and are fed to a refuse burner in the boiler-room.

The fuel thus obtained is sufficient to keep this burner operating all during working hours. It heats a 500-gal. water tank, which, in turn, furnishes hot water ample to supply all of the wash basins throughout the building.

FIG. 1 FLOOR CLEANING EQUIPMENT FOR SHOP

New Cost Formulas for Firebrick

This Method of Costing is Applicable to Any Product Having a Series of Sizes

By GEORGE W. GREENWOOD

Secretary and Treasurer, Warren Lumber and Supply Company

AS a laboratory for working out problems in management, accounting, cost finding, preferred numbers and all other industrial experiments, few can compare with the ancient clay products industry. Consider but one branch—the manufacture of firebricks.

To the uninitiated, even among those with extensive business experience, a firebrick factory is but a place where mud is molded into rectangular bricks measuring about 9 by 4 by 2½ in. For instance, during the fuel conservation period in the World War, one of the executives in charge at Washington decided to put all brick manufacturers on the same plane, whether they made firebrick, face brick, common building brick, paving brick, or any of the other kinds whose very names would mean nothing to most people aside from those who make and use that particular product. At a conference among firebrick manufacturers who were figuring on ways and means to enlighten this particular official in the fuel department, it was finally decided to explain to him that wherever there was a fire necessary, firebricks were necessary; and that to stop the manufacture of firebricks, or to curtail their output by shutting off their fuel supply, would to that extent put out the fires in the nation's furnaces, forges, power-plants, bake ovens—in fact, all fires either for comfort or for commercial use. He saw the force of the argument and, fortunately for the country, the firebrick manufacturers were urged to run at full blast.

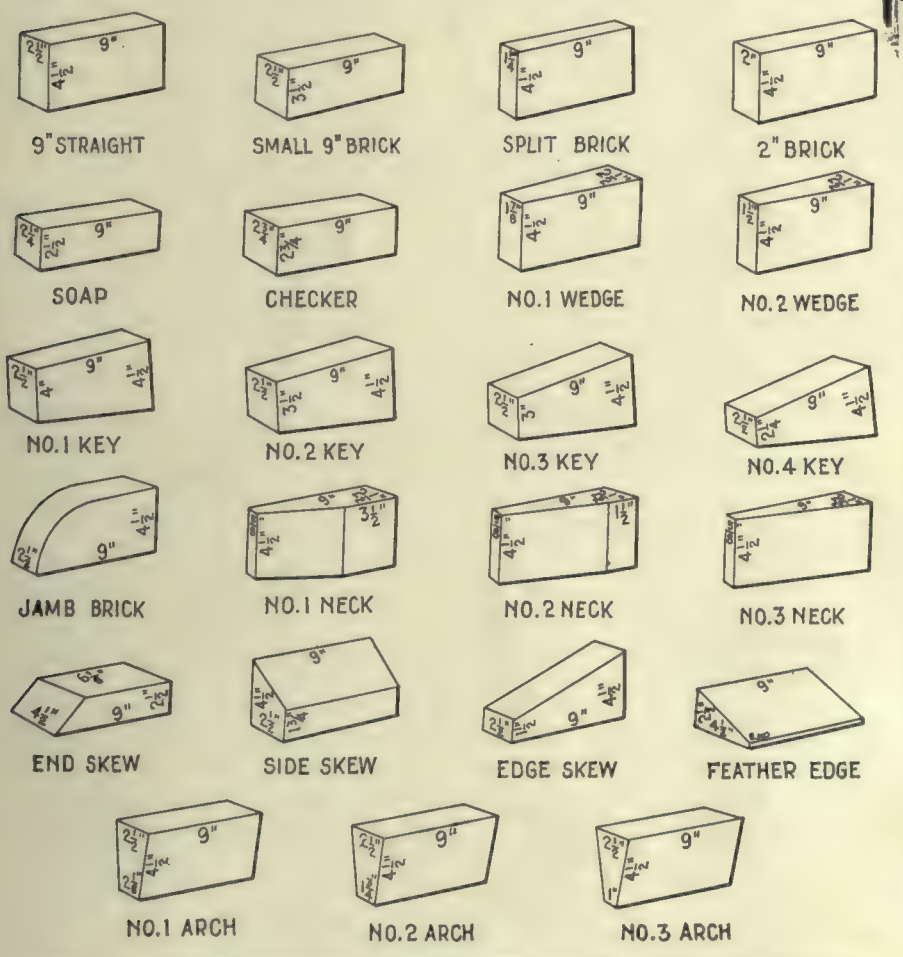


FIG. 1 STANDARD FIREBRICK SHAPES DERIVED FROM THE "9-IN. STRAIGHT"

But firebricks about 9 in. long are but a small part of the output of the usual firebrick factory.

Fireclay is molded into an inconceivable variety of shapes, there being over a score of designs—all standard—obtained merely by cutting off a part of a 9-in. brick, so as to form a wedge, a key, an arch, etc. (see Fig. 1). Some 9-in. bricks and some of the simpler shapes (everything other than a 9-in. brick is a "shape") are turned out in large numbers by machines, using dry press, soft mud, stiff mud, or other machine, depending upon the particular use of the product, while others are turned out a few at a time by hand, using a process but little different from that employed in ancient Egypt. Some shapes are small, weighing but 2 or 3 lb., while others are large, limited only by the possibility of drying them and getting them safely burned in the kilns.

Some of the shapes are rectangular, generally known in the industry as "tiles," while others have all the complexities of an iron casting—curved surfaces, tongues and grooves, flanges, notches, indenta-

tions, perforations, etc. Under the circumstances, any attempt at a cost system is a staggering undertaking.

Shapes are classified in many ways, but for cost-finding purposes one important factor is size, or weight. This is usually expressed, not in pounds, but as a ratio to the standard 9-in. brick. For this purpose, 95 cu. in. is taken as the size of the standard brick, and this is divided into the number of cubic inches in a rectangular tile, giving its "9-in. equivalent". For instance, a tile measuring 22 by 11 by 3 is equivalent to 7.64 nine-in. brick. A common method of arriving at the output for a month is to multiply the number of shapes of every kind by their corresponding equivalents and to take the total.

How Costs Are Figured

Many manufacturers take their operating costs or expenses for a month, regardless of whether the expense was incurred operating or standing still, and divide this sum by the 9-in. equivalent molded, without regard to complexity of the shape, securing a quotient which they call the "cost per thousand, 9-in. equivalent". To find the cost of any particular shape, they multiply this quotient by the 9-in. equivalent of the shape, without regard to its complexity or size.

This mysterious rite is harmless enough, and one particular advantage is that it affords employment to cost accountants, reminding the writer of the reply of an instructor in non-Euclidean geometry to the question as to its practical application—the instructor replied, "It keeps a roof over my head". But the sad part of the process is that managers look upon these quotients with respect, and even define a profit or a loss as the difference between this quotient and the selling price of the shape.

Of course, the operating and overhead expenses should be segregated into those due to operation and those due to inoperation; the time-measured element should be "weighted" to allow for full and for lean years; a distinction should be attempted between bricks partly manufactured in one month but completed in another, and bricks which are completely processed during the month; and, finally, some intelligence should be shown in allocating expenses between easy and difficult shapes, having the same equivalent. Of course, to do this accurately is impossible.

It is far more complicated than the problem of three bodies moving under their mutual gravitational attraction, but for which problem there is no answer in the back of the book. Brick manufacturers, like others, are divided into two classes—those who do not know their costs, and those who *know* that they do not know their costs.

But as a look in the direction of cost finding, first consider setting up of standard costs of rectangular shapes, leaving for the future—the rather distant future, in fact—an attempt to set standards for more difficult patterns. In connection with rectangular tile, consider any length from 10 in. to 50, any width from 5 in. to 40, any thickness from 3 in. to 10, and we at once have several thousand different tiles if we consider only integral dimensions, and as tile dimensions usually involve fractions, the variety of this simplest of all classes is appallingly great. And after setting standards for such tiles, there remain the beveled, perforated, curved, grooved, and other shapes. Is it any wonder that cost finding in the firebrick industry is where it was in the time of Pharaoh?

Now a tile with an equivalent of 10 bricks is at least 10 times as expensive to make as a brick, assuming that both are made by hand. Compared with a machine-made brick, the factor would be far greater than 10. But in addition to the factor 10, there is an added

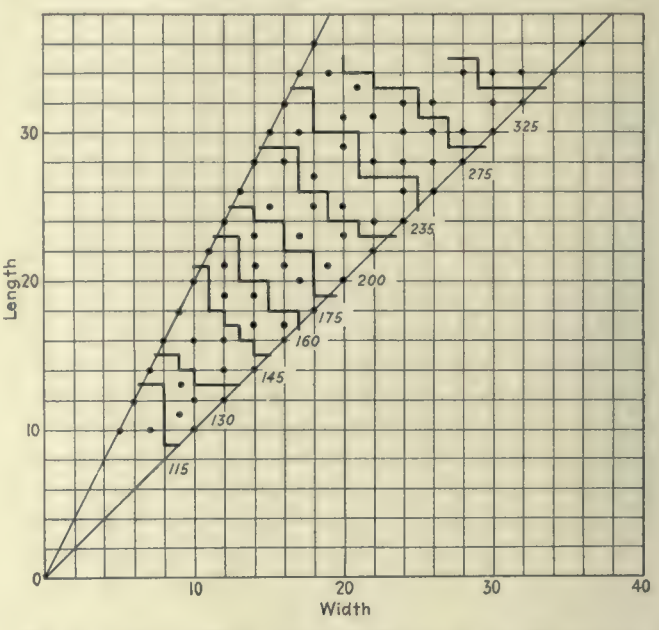


FIG. 2 COST FACTORS (FROM EXPERIENCE) FOR FIREBRICK TILE 3 IN. THICK

Both length and width are expressed in inches and the ratio of width to length ranges from 1:2 to 1:1.

factor on account of the increased difficulty of making the larger block. And the next step is to determine some sort of intelligent factors which represent this added cost. Let us call this the cost factor.

Now the cost factor of a tile whose width is half its length is probably less than the cost factor of a tile of the same length and thickness, but which is either wider or narrower because of a greater loss in manufacture. Also, a tile 3 in. in thickness is in general the most economical to make. To begin with, consider tiles 3 in. thick, and on a sheet of squared paper indicate tiles ranging in length from 10 in. to 36 in., and whose widths extend from one-half their lengths to the same as their lengths, taking only those for which cost factors have been approximated (see Fig. 2).

Taking the cost factor of a standard brick at 100, suppose rough approximations to cost factors for the tile indicated have been made, which are found to fall into classes from 115 to 325 as shown. Thus a tile 22 by 11 by 3 would have a standard cost not only 7.64 times that of a 9-in. brick, 7.64 being its equivalent, but this product would be multiplied by 1.60 to arrive at its standard piece cost. Of course, this does not mean that each tile in a given territory actually has the same cost factor; it merely means that the cost

factors hover around that central figure. Our problem is to evolve an equation which will fairly represent these results.

Formula for Tiles 3 In. Thick, Widths ½ Lengths

Consider first tiles 3 in. thick whose widths are one-half their lengths. The empirical results shown on the chart are as follows:

Dimensions of 3-In. Tile in Inches	*Cost Factor Derived from Fig. 2*	*Dimensions of 3-In. Tile in Inches*	*Cost Factor Derived from Fig. 2*
10 x 5	115	24 x 12	175
12 x 6	115	26 x 13	200
14 x 7	130	28 x 14	200
16 x 8	145	30 x 15	235
18 x 9	145	32 x 16	235
20 x 10	145	34 x 17	275
22 x 11	160	36 x 18	275

Plot these results, using cost factors as ordinates and widths as abscissæ (see Fig. 3).

It will be seen that the cost factor rises with increasing rapidity—a fact apparent to every firebrick manufacturer. Evidently the cost factors need a lot of smoothing out to eliminate the stair steps, and the general form suggests a parabola with its axis vertical. This suggests that the cost factor is a function of the area of the tile. Assuming that the parabola would have the line $W = 5$ as its axis, the equation is probably of the form

$$y = mWL + c$$

where y is the cost factor, W the width, and L the length. By drawing a large number of these curves for different values of m and c, it will be found that the parabola

$$y = 0.28WL + 100$$

will give a smooth curve which runs the gamut of the points with a fair degree of impartiality. The values of the cost factors of these particular tiles based on this equation are as follows:

Dimensions of 3-In. Tile in Inches	*Cost Factor Derived from Equation*	*Dimensions of 3-In. Tile in Inches*	*Cost Factor Derived from Equation*
10 x 5	114	24 x 12	181
12 x 6	120	26 x 13	195
14 x 7	127	28 x 14	210
16 x 8	136	30 x 15	226
18 x 9	145	32 x 16	243
20 x 10	156	34 x 17	262
22 x 11	168	36 x 18	281

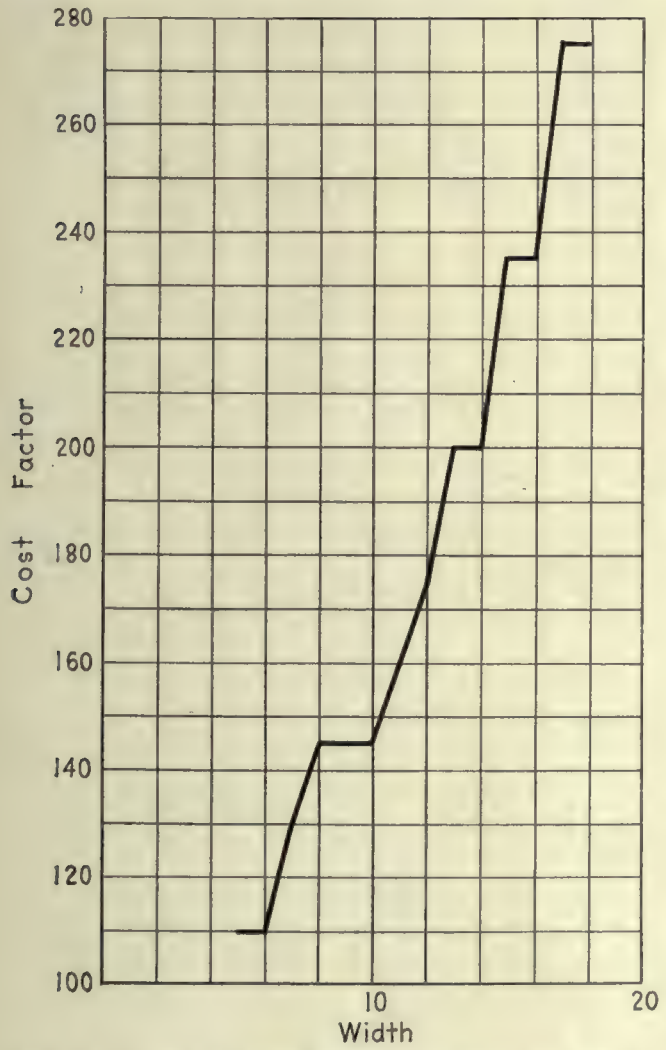


FIG. 3 RELATION OF COST FACTORS AND WIDTHS FOR FIREBRICK TILE 3 IN. THICK

Width is expressed in inches and ratio of width to length is 1:2.

This formula will now give the standard cost of any tile 3 in. in thickness, whose length is twice its width. For instance, if the standard cost of 9-in. brick, taken as 100, is $20 a thousand, the standard factory cost of a tile 25 by 12½ by 3 is found, first, by multiplying by the 9-in. equivalent, 9.87 (found by dividing the volume by 95), and then applying the cost factor given by the formula

$$y = 0.28 \times 12.5 \times 25 + 100$$

which gives as the cost factor, 187.5. The result is $\$20 \times 9.87 \times 1.875$, or $370.12 per 1000 pieces, that is $0.370 per piece, since it is customary to assign piece prices to the nearest tenth of a cent in costing shapes.

Thus standard factory costs, based on a standard cost of 9-in. straights, have been evolved for 14 out of the many thousands.

Formula for Tiles 4 In. Thick, Widths ½ Lengths

Next make a chart of tile 4 in. thick, covering such rough approximation of costs in comparison with the standard cost for 9-in. brick, as have been obtained. Suppose the approximate costs of 4-in. tile whose widths are half their lengths fall into these groups:

Dimensions of 4-In. Tile in Inches	*Cost Factor*	*Dimensions of 4-In. Tile in Inches*	*Cost Factor*
10 x 5	130	24 x 12	200
12 x 6	130	26 x 13	200
14 x 7	130	28 x 14	200
16 x 8	145	30 x 15	235
18 x 9	160	32 x 16	275
20 x 10	160	34 x 17	275
22 x 11	175	36 x 18	275

Charting these as was done with the 3-in. tiles in Fig. 2, and trying out a large number of parabolas with $y = 5$ as axis, it is found that

$$y = 0.27WL + 110$$

will eliminate discrepancies and give consistent results which will average up fairly with those roughly found.

Formula for Tiles 5 In. Thick

Next taking tiles 5 in. in thickness, the corresponding parabola found is

$$y = 0.26WL + 120$$

Next compare these cost factor curves for tiles whose widths are half their lengths:

Tile 3 in. thick, $y = 0.28WL + 100$
Tile 4 in. thick, $y = 0.27WL + 110$
Tile 5 in. thick, $y = 0.26WL + 120$

From these, one would suspect that the equation for tile 6 in. thick would be

$$y = 0.25WL + 130$$

and upon charting empirical results for such few tiles as have been approximately costed in this thickness, it is found that the formula gives satisfactory results.

As we proceed to tile of greater thickness, we have fewer and fewer cases to guide us, and the errors in empirical results are therefore less liable to cancel each other, but we find that a generalization of this formula will afford dependable standard costs.

The generalized formula for all tile 3 in. or more in thickness, whose lengths are twice their widths, is easily seen to be

$$y = [0.28 - 0.01(T-3)]L \times \frac{L}{2} + [100 + 10(T-3)]$$

or $y = (0.155 - 0.005T)L^2 + (70 + 10T)$

where T is the thickness.

Formula for Tiles Whose Lengths Equal Widths

So far we have considered only tiles whose lengths are twice their widths. It has been like taking a vertical section of a layer cake with many strata. We now proceed to take another vertical section, this time through the outcrop or terminal boundary where the widths of the tiles equal their lengths. Beginning again with 3-in. tile, draw a line from the origin to the point representing a 36 by 36 tile and set down the series of rough cost factors for tile 10 by 10, 12 by 12, etc., as shown in Fig. 2. Plotting these cost factors as before, after repeated trials one chooses as an equation whose graph will iron out the inconsistencies of the series, the parabola

$$0.245L^2 + 100$$

The parameter, 0.245, is seen to be 0.875 times that of the parabola when the width is half the length. Next investigate the corresponding series for square tile 4, 5 and 6 in. in thickness, and it will be found in each case that a parabola with a parameter 0.875 the corresponding parabola for semi-square tiles will give reasonably good results. It must be remembered that the observed cost factors contain a considerable amount of error, and that the calculated amounts are in any case consistent and probably more dependable.

Multiplying the parameter of the general equation for semi-square tile by 0.875, the general equation for tile 3 in. or more in thickness, whose widths and lengths are equal, becomes

$$y = 0.875[0.28 - 0.01(T-3)]L^2 + [100 + 10(T-3)]$$
or $y = 1.75(0.155 - 0.005T)L^2 + (70 + 10T)$

Formula for Semi-Square to Square Tiles

For tiles whose widths vary from one-half their lengths to equality with their lengths, it appears therefore that the general equation is a parabola belonging to the same family, the parameter being multiplied by a function of the ratio of the width to the length. One will not make any very serious error by assuming that the multiplier increases uniformly as the width increases, that is, that the isocostal lines in Fig. 2 over the area considered are straight. The multiplier is therefore of the form $m + nr$, where $r = W/L$, the value of the expression being 1 when $r = \frac{1}{2}$, and 1.75 when $r = 1$. The expression therefore becomes

$$\frac{0.25L + 1.50W}{L}$$

and the general equation for all tiles from semi-square tile to square tile, 3 in. or more in thickness, becomes

$$y = (0.25L + 1.50W)(0.155 - 0.005T)L + (70 + 10T)$$

By this formula, using a base of \$20 per thousand for 9-in. straight brick, the standard piece price of a tile 20 by 16 by 4 is found by multiplying by its 9-in. equivalent, 13.47, and by its cost factor as found by putting 20, 16, 4 for L, W, T in the above equation, so that the standard piece price becomes

$$\frac{\$20 \times 13.47 \times 1.883}{1000}$$

or \$0.507.

As tile becomes narrower, the cost factor increases; as it becomes less than 3 in. in thickness, the cost factor increases; in each case it becomes infinite when the impossibility of making an extremely narrow or an extremely thin tile is reached. However, these latter questions relate purely to the firebrick industry, as does also the investigation as to the modifications of the cost factor due to beveled, perforated, or other irregular shapes.

But the discussion up to this point should be applicable to any industry such as a foundry, a machine shop, a planing mill, or other factory making a large variety of products.

What Are Patents Worth?

By H. A. TOULMIN, Jr.

Of Toulmin and Toulmin, Patent Attorneys

At some time every business man wants to know how to arrive at an accurate valuation of patents and trade-marks. As a borrower or seeker of additional capital, he will want to correctly evaluate his own property of this sort. As an investor of his own or his company's funds, he should be able to judge of the value of another company's patents and trade-marks. When he extends any considerable credit to a customer, he should look into the value of these assets just as closely as he does into the values of plant, accounts receivable, and inventories.

Factories may burn and put the concern out of production for many months, but if the patents are valid and valuable, the market for the patented products will still be controlled. Accounts receivable may go bad and inventories depreciate by half and so cause serious financial trouble, but if the patents are sound the storm can be weathered. It is hard to conceive of a financial storm that would permanently put, say, the National Cash Register Company out of business. Its patents would give it the ability to borrow enough money to see it through.

On the other hand, even tremendous financial resources will not save the company whose patents prove to be invalid if its business is chiefly the selling of patented articles.

Wreck of a Tire Manufacturer

For example, take the case of a manufacturer of solid rubber tires, whose entire business depended upon what was generally considered to be a pioneer patent. For years it had done an unusually profitable business. Its stock was listed on the New York Stock Exchange and was so widely traded in that the company was considered one of the country's leading industrials.

Note that I said that its patents were *generally considered* to be pioneer grants. Actually, no careful test of their validity had ever been made. Investors held hundreds of thousands of dollars' worth of the stock on faith. It was customary to have appraisals made of the plants, but not of the patents upon which the operation of the plants depended.

Some competitor, in time, decided that the tire company's patents were not beyond question. As the result of a court contest the Court of Appeals invalidated the patent that gave the concern its market monopoly. Its stock crashed from a high price to nearly nothing. The investors who took the value of the patents on faith lost heavily, because this faith had no basis in fact.

Another historical case of the sort is that of one of the early airplane manufacturers. The Wright brothers sued them and won. The company went into the receiver's hands. These are examples of the possible consequences to a business of improperly evaluating the worth of their patents.

Patent Litigation Expensive

Serious commercial situations may arise in patent cases through the expense of litigation, the money recovery or damages, or the injunction which forces the company to desist from manufacturing the patented product. Sometimes all three combine to make the condition still more disastrous.

Another instance is that of an old and prosperous manufacturer of automobiles who took on a new line of products. New patents had a material bearing upon the soundness of this company's financial condition. Hard times arrived when the competition for orders was keen. The company claimed certain patents and, in order to preserve its business, sued its competitors under those patents.

If it had been able to sustain its patents, it would not only have got the business from its competitors, but would have secured large recoveries as well. It failed to do so because its patents were held to be invalid, and as a consequence, it not only lost these advantages, but, having lost such prospective assets, it was forced into the hands of a receiver—a situation it would have been saved from if its patents had been valid and sustained. As a result, stockholders and creditors took heavy losses. Here was a case where the company itself did not know the value of its patents. It made the mistake of guessing that they were valid and blithely went after competitors only to find that the supposed bedrock of patent values was quicksand.

The Bankers' Suspicion

It is probably such cases as these that have led bankers to look with suspicion on all patents and to strike out from the statement any valuation of patents and trade-marks above one dollar. They have seen many concerns which put a high valuation upon these items, fail when they were assailed. Under the usual conditions, their point of view can be understood, for, while a valid patent may be of more value than all of the other assets, one that ultimately turns out to be invalid may prove to be an unsuspected liability that will offset all of the tangible assets.

While to be told by a banker that patents and goodwill are worth at most one dollar has irritated many manufacturers, the source of the trouble really lies with them instead of in what they usually call the "stupidity of a hard-shelled Shylock". There is a remedy available. Where the value and validity of patents and trade-marks have been investigated and certified to by experts, most far-sighted bankers will consider them as real assets. This is not a new pro-

cedure although not, it is true, generally followed. Yet it is certainly as worth while as to have appraisers certify to the value of the physical plant and public accountants certify to the value and existence of inventory and accounts receivable.

How to Estimate Value of Patents

There are a number of ways in which the value of the patents can be estimated. An important point is whether royalties are paid to the company under its patents or whether it pays royalties to others. Another factor of importance is to determine whether the company is in a line in which there is sharp competition, and whether its competitors hold patents which may lead to lawsuits later. Such ownership of patents is all on record, and with advice of competent specialists, bankers and investors can determine the situation in any particular cases.

One of the best indications of a company's stability is its progressiveness in maintaining experimental departments and laboratories for the continued development of the product and the protection of such developments by patents.

The effect of the license or royalty fee is this: If the company has to pay a certain royalty on each machine it manufactures, it is obvious that the competitor who is licensing it will have just that much advantage in fixing the price and in getting business. If, on the other hand, the company receives this royalty from its competitors, it not only receives the money but also has the price advantage due to a lower cost.

The cost of experimental work, of obtaining patents and of maintaining them, can properly be capitalized and, if desired, can be depreciated, year by year, at the rate of $\frac{1}{17}$ per year, as patents run for 17 years. The same thing may be done with trade-marks, and the investment made in building up good-will under trade-marks can be capitalized and depreciated. Incidentally, this may have a material bearing upon the income tax situation.

One of the ways of determining the value of patents is to see if the machines embodying such patents are manufactured and put out on lease. If so, the contracts of lease may indicate that the machines have a certain investment value, as they will be sure to yield from the lessees a stipulated rent, month by month, over a period of years. Such values may be set up on the books and capitalized.

Another test of the value of the patents is: What saving will the patented machine make in the production cost of a product? This saving, capitalized and figured at 6 per cent, would accurately represent the value of these improvements in turning out the product. Again, the patented machine may not reduce the cost per article, but may produce so many more articles per day that the trade may be completely dominated by the supply. This may prevent competition from entering the field with any hope of success. Such a situation has a very real asset value.

If the business receives the benefit, through a patented article or a patented machine, of an entirely new field, it would be fair to figure the value of such new business with the old equipment and old overhead, so that the real value of the patented improvement might be arrived at.

The Question of Infringement

From the investor's and banker's point of view, there should always be a report of competent specialists as to whether any of the products of the company infringe any competitor's patent. Patent lawsuits are serious. They often involve large recoveries and frequently involve injunctions. Even the publicity attached to litigation may have a depressing effect upon the value of a company's stock and unfavorably affect its credit.

Instead of valuing patents and trade-marks in the balance sheet at some fanciful figure, or entirely eliminating the item, manufacturers should be encouraged, even required, to place a sound value upon them and support the figure with a certified report. In that way the danger of overvaluation will be eliminated, and valuable profit-making possibilities revealed that would not be apparent if the old "one dollar" rule were followed. Most any banker or commercial house would rather extend to a manufacturer a line of credit of $200,000 instead of only $100,000, provided the statement shows that the concern deserves it. Accurate valuation of patents will often show a real borrowing capacity much higher than when patents are considered valueless.

Questions in the Appraisal

In setting up a real value of patents and trade-marks, the following questions should be answered by the specialists who are asked to make the appraisal. It is essential to *know* the answers to them, not to guess them.

1. Does the company maintain experimental departments and patent the production of these departments?
2. Does the company's production infringe the patents of anyone else?
3. Does the company employ patented machines for producing its product or does it make a patented product upon which it has a monopoly?
4. How long have its patents to run?
5. Has it trade-marks which it has widely advertised and which insure the continuity of the business even though its physical assets may be temporarily destroyed?
6. Is the company obligated to pay license fees to other companies, or does it receive license fees from other companies so that it will have a predominating differential in fixing its price in order to get business?
7. Have the patent and patent properties been appraised by competent experts?
8. How are such assets set up on the books of the company?
9. Has the company foreign patents and trade-marks to protect its foreign trade?

Handling a Complex Material Inventory

Quick Systematic Method of Determining Turnover and Changes in Total Value

By RUDOLPH ROSENTHAL

Assistant Treasurer, Jacques Kahn, Inc.

WE recently faced a situation where it was necessary to develop a report for our board of directors on the condition of our factory stock. The two questions involved were: What is the turnover of the stock? What, approximately, is the amount of the reduction in stock value on account of changes in raw material cost? Both questions could only be answered on the basis of a previous stock analysis. The main problem lay in a clear presentation of the turnover, as developed in the tables accompanying this article, which show the method adopted.

Specifically ours are the problems of the small factory, working on orders only, many down to the smallest in size. The stock consists of raw material, plate glass, work-in-process, but no finished goods as a rule. There is no standardization of any kind in the trades to which we sell—furniture manufacturers, framers, fixture manufacturers, etc.—therefore, while the qualities of raw material and finished goods are few, the sizes are of the greatest variety.

We buy glass from the factories cut to size for the larger orders, or in big sheets, called stock sizes, which we cut down to our requirements. This method brings about a gradual accumulation of raw material stock consisting of remaining sizes, which move but slowly. This amount is increased in our case, as sometimes only part of the quality and sizes purchased can be used for the high-quality product in which we specialize.

We keep in our visible card system stock cards for about 4500 sizes, original and salvage, as we call the cut downs, of which about 4000 belong to the four main qualities.

The regular yearly inventory and balance figures showed a turnover of the stock three times a year, which seemed satisfactory until the total increase of stock caused a more detailed investigation. The analysis of stock showed that, while 1300 sizes had the very good turnover of six times a year, the other

TABLE 1. INVENTORY COMPARISON OF SIZES AND UNITS AS OF JANUARY 1*

The inventory as a whole shows a decrease in the number of sizes which is favorable. Index figures of stock in the different qualities and totals have to be compared with production indexes of the different qualities and totals (not shown here) to give a complete comparison.

Quality	1922			1923			1924		
	Sizes	Units	Index	Sizes	Units	Index	Sizes	Units	Index
A	372	4,003	85	213	1,864	40	137	1,454	31
B	491	4,151	57	260	4,188	58	425	10,038	140
C	841	20,367	106	700	12,388	65	1,003	24,663	129
D	861	8,998	100	483	3,269	36	218	570	6
E	243	6,456	96	487	6,141	90	232	5,451	80
F and G	657	36,260	73	525	30,688	72	477	27,412	63
Total	3,465	80,235	.....	2,668	58,538	.....	2,492	69,588	.....

* The original index figure of 100 used in preparing this and the following tables, was based on the average of 5 previous years (1915-20).

TABLE 2. INVENTORY COMPARISON OF VALUES AS OF JANUARY 1

This table shows that decrease and increase in units do not correspond with values as prices change. The change in prices per unit shown on a different table is not reproduced here. This table should be compared with yearly production and sales totals and indexes.

Quality	1922		1923		1924	
	Value	Index	Value	Index	Value	Index
A	$13,987	82	$6,547	38	$4,514	26
B	10,756	38	13,037	46	27,770	99
C	30.313	57	22,526	42	60,528	113
D	19,927	100	4,623	23	1,358	6
E	1,106	71	972	62	936	60
F and G	11,274	90	9,549	76	8,789	70
Total	$87,363	.....	$57,254	.....	$103,895	.....

TABLE 3. YEARLY TURNOVER IN TOTAL VALUES AND PERCENTAGES OF TOTAL RECEIVED

This table shows the yearly changes in stock at beginning and end of year, as brought about by purchases and by use. It should be compared with a table of average cost per unit.

	1921		1922		1923	
	Amount	%	Amount	%	Amount	%
Stock Jan. 1	$145,844	41	$87,363	26	$57,354	13
Purchases	209,830	69	242,938	74	378,466	87
Total	$355,674	100	$330,301	100	$435,820	100
Used	$268,311	75	$272,947	83	$331,925	75
Stock Dec. 31	87,363	25	57,354	17	103,895	25

TABLE 4. TURNOVER IN QUANTITY OF EACH ARTICLE IN 1923 EXPRESSED IN PERCENTAGES OF TOTAL RECEIVED*

Quality	In Stock 1/1		Received		Total		Used		In Stock 12/31	
	Quant.	%	Quant.	%	Quant.	%	Quant.	%	Quant.	%
A	1,864	43	2,511	57	4,375	100	2,838	65	1,537	35
B	4,188	12	30,067	88	34,255	100	24,104	70	10,151	30
C	12,388	17	61,863	83	74,251	100	48,607	65	25,644	35
D	3,269	73	1,214	27	4,483	100	3,584	80	894	20
E	6,141	66	3,141	34	9,282	100	3,918	42	5,364	56
F	4,344	93	381	7	4,675	100	902	20	3,773	80
G	26,935	100	.....	.....	26,985	100	1,563	6	25,422	94
Total	59,129	.....	99,177	.....	158,396	.....	85,516	.....	72,785	.....

* See note under caption of Table 5.

TABLE 5. TURNOVER IN VALUE FOR EACH QUALITY IN 1923 IN PERCENTAGES OF TOTAL RECEIVED

Tables 4 and 5 show the turnover for each quality during the year. The quantity or amount received represents not only purchases but also transfers from one to the other quality and increase through cut down from larger sizes. The stock figure at the end of this year includes the material in work-in-process.

Quality	In Stock 1/1		Received		Total		Used		In Stock 12/31	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
A	$6,547	34	$12,934	66	$19,481	100	$15,064	77	$4,417	23
B	13,037	9	131,517	91	144,554	100	114,745	79	29,809	21
C	22,526	9	246,272	91	268,798	100	202,091	75	66,707	25
D	4,623	59	3,214	41	7,837	100	6,260	80	1,577	20
E	972	35	1,814	65	2,786	100	1,634	58	1,152	42
F	5,355	63	3,121	37	8,476	100	3,660	43	4,816	51
G	4,319	90	463	10	4,782	100	334	7	4,448	93
Total	$57,379	....	$399,335	....	$456,714	.....	$343,788	....	$112,926	....

TABLE 6. CLASSIFICATION OF GOOD AND BAD TURNOVERS

This table indicates that 3314 sizes had a bad turnover, of which the 1700 in quality B amount to the most considerable sum in relation to the total. Further analysis in the manner of this table gave a ranging of all classes from best to worst turnover and conclusions as to elimination, etc.

Good Turnovers

Sizes	Quality	Classification	Amount Used	Value of Inventory	Turnover
46	A	Over 1,000 units	$10,288	$819	12.5
59	B	Over 500 units	163,822	25,921	6.2
473	C	Over 100 units	108,648	20,939	5.2
747	D	Over 100 units	6,260	1,577	4.0
1,325		Total	$288,958	$49,256	5.9

Bad Turnovers

213	A	Below 1,000 units	$4,836	$3,859	1.2
1,700	B	Below 500 units	38,269	40,786	0.9
909	C	Below 100 units	5,249	5,707	0.9
399	D	Below 100 units	6,097	8,870	0.7
93	F-G	all units	334	4,448	0.07
3,314		Total	$54,785	$63,670	0.9
4,639		Total all turnovers	$343,743	$112,926	3.0

3200 turned over less than once a year. On some qualities and sizes hardly any raw material is ever in stock for any length of time, the turnover being so rapid; for many other qualities the stock serves as a clearing house and there is a reasonable turnover; but very many sizes represent salvage, with a very slow turnover. To a large degree, of course, they form the reserve for quick deliveries of small orders.

To represent actual conditions it was, therefore, necessary to analyze inventories as well as turnover.

Tables 1 and 2 show the comparison of inventories, indicating increase and decrease with index figures. These inventory figures represent momentary or final conditions and, of course, give little clue as to what happened during the year. We can get this information though from Table 3, which shows the actual turnover by figuring the total material available as 100 per cent, and further how this amount is composed of stock and purchases and is used up by manufacturing, leaving a different stock accumulation at the end of the year.

This periodical table leads to the yearly analysis of turnover, by gradually investigating qualities, and sub-classifications as to good and bad turnover. The result of such analysis is the final elimination of groups or sizes, which must be closed out. Tables 4, 5 and 6 show the method of analyzing this turnover.

As mentioned before, the reason for the accumulation of bad stock is mainly stocking salvage glass. Since current sizes remain only a short time in stock, their presence at inventory time is purely accidental, and the stock remaining from year to year is more or less of the same composition. This is best shown by a comparison of unit costs given in Table 7.

Now we come to the other problem: How to estimate quickly the effect

TABLE 8. LAST STOCK VALUE PER QUALITY AND BRACKET COMPOSITION

Quality	Value	Bracket	Per Cent of Total
A	$5,000	R	4
B	32,000	S	19
C	50,000	T	15
D	24,000	U	34
E	12,000 (no cost change)	V	26
Total	$123,000	W	2
			100

TABLE 9. EXAMPLE OF RAW MATERIAL COST CHARGE PER BRACKET AND QUALITY AND PER CENT DIFFERENCE

Bracket	Quality A Cost			Quality B Cost			Quality C Cost			Quality D Cost		
	Old	New	% Diff.	Old	New	% Diff.	Old	New	% Diff.	Old	New	% Diff.
R	64	50	22	58	45	22	48	41	15	....	....	.....
S	80	60	25	72	55	23	62	50	20	....	....	.....
T	96	84	12	87	77	12	77	70	10	....	....	.....
U	115	97	16	103	88	14	93	80	14	55	45	8
V	125	111	11	110	101	8	96	93	.....	73	62	15
W	135	123	9	120	112	7	100	102	.....	80	69	14

TABLE 7. COMPARISON OF UNIT COSTS USED AND STOCK WITH INDEXES

This table shows first that the stock remained the same, the increase in unit cost being caused by an increase in prevailing prices at time of inventory which for qualities A-E was about 35 per cent. Second, that the factors we used corresponded, as to unit cost (which as an average represents size mainly), exactly to what was received.

Quality	Stock Comparison				Stock, Received and Used					
	In Stock 1/1		In Stock 12/31		Received		In Stock 1/1 and Received		Used	
	Unit Cost	Index	Unit Cost	Index	Unit Cost	Index	Unit Cost	Index	Unit Cost	Index
A	3.51	100	2.87	82	5.15	115	4.45	100	5.37	120
B	3.11	100	2.93	94	4.38	104	4.22	100	4.35	103
C	1.82	100	2.60	143	3.98	110	3.62	100	4.16	115
D	1.41	100	1.76	125	2.65	145	1.75	100	1.74	100
E	0.16	100	0.21	130	0.58	193	0.30	100	0.42	140
Sub-total	1.71		2.38		4.01		3.50		4.09	
F	1.23	100	1.27	103	0.82	45	1.81	100	4.00	221
G	0.16	100	0.17	106	0.18	100	0.18	100	0.21	116
Total	0.95	....	1.55	....	4.00	....	2.90	.....	4.00	.....
Increase in Unit Cost Purchases	1.95	100	2.64	135						

TABLE 10. AVERAGE AMOUNT OF STOCK OF EACH QUALITY IN THE DIFFERENT BRACKETS AND REDUCTION IN VALUES

Amount per Bracket		Quality A			Quality B			Quality C			Quality D		
Bracket	%	Stock	%	Reduction Amt.	Stock	%	Reduction Amt.	Stock	%	Reduction Amt.	Stock	%	Reduction Amt.
R.....	4	$200	22	$44	$1,280	22	$282	$2,000	15	$300	$960	....	.....
S.....	19	950	25	238	6,080	23	1,398	9,500	20	1,900	4,560	....	.....
T.....	15	750	12	90	4,800	12	576	7,500	10	750	3,600	....	.....
U.....	34	1,700	16	272	10,880	14	1,523	17,000	14	2,380	8,160	8	$653
V.....	26	1,300	11	143	8,320	8	666	13,000	....	.....	6,240	15	936
W.....	2	100	9	9	640	7	45	1,000	....	.....	480	14	67
Total..	100	$5,000	....	$796	$32,000	....	$4,490	$50,000	....	$5,330	$24,000	....	$1,656

of a change of cost in part of the raw material on the total stock value. To figure over 4000 sizes in square feet with different changes in unit cost would take quite some time. Therefore a key had to be found to estimate the total with sufficient accuracy. Our raw material prices are based on square feet, but the unit cost differs with the size of the plates. The square foot unit in larger plates is higher than in smaller ones. Each range, for example, between 5 and 7 sq. ft., is called a "bracket," but some sizes with one very long dimension are partly ranged into brackets higher than would correspond to their square area.

Tables 8 to 11 demonstrate the method used in figuring these cost changes. Table 8 shows the value of stock at last inventory. If the monthly inventory totals only are shown, the composition of the inventory has to be estimated according to percental composition of different qualities at the beginning of the year. Purchases and manufacturing records brought up to date will give the correct composition at a given date during the year at prevailing cost. This table also shows the average bracket composition of stock in percentages as found in yearly stock analysis.

A new price list of raw material brought about a decrease in prices as shown on Table 9, giving the decrease in percentages for each bracket and quality. The next step is shown on Table 10. The total amount of each quality in stock is distributed according to percental bracket composition. The corresponding percentage in cost reduction is then taken off.

TABLE 11. TOTAL STOCK VALUE WITH COST REDUCTION AND DEPRECIATION

Quality	Stock Value	Reduction	Reduced Value	Depreciation %	Depreciation Amount	Net Value
A.....	$5,000	$796	$4,204	5	$210	$3,994
B.....	32,000	4,990	27,510	5	1,376	26,134
C.....	50,000	5,330	44,670	10	4,467	40,203
D.....	24,000	1,656	22,344	10	2,234	20,110
E.....	12,000	.....	12,000	10	1,200	10,800
Total...	$123,000	$12,772	$110,728	.....	$9,487	$101,241

Total original	$123,000
Total reduction	21,759
Per cent reduction	17.7

Finally, in Table 11 we find the totals listed of the reduced stock value, from which the usual inventory depreciation has to be deducted, to give the final result.

How About Training Salesmen?

IT is said that salesmen, like violinists, are born, not made. If the simile holds true, then salesmen, born that way, need a great amount of training, like violinists, before they are worth their salt. So far, however, most of their training is received in the school of hard knocks—hard for the green salesman, and doubly hard for the goods that he is trying to sell. The fortunes that have been lost through the employment of green men of unquestioned good intention would more than likely pay off the national debt with some to spare to put Europe on its feet.

Granted that a poor salesman is a liability rather than an asset, what is being done to overcome it? There are a few firms, very few, that deliberately try to train men to represent them. These few usually sell a technical product, and the training which they give is largely on the technical representation of the goods. In other words, they are selling by demonstration rather than persuasion. This side of salesmanship is easy to comprehend. The salesman who knows all the good points of his product, but not so much that he neither clouds his talk with purely technical terms nor appreciates its weaknesses is well equipped to meet the class of customers who buy because they expect that it will be profitable for them to do so.

But how about that large number of salesmen who really have nothing to offer that is not offered by a dozen competitors? How about the training for a bond salesman who knows that the man who preceded him and the one that follows him have just the same price limitations and are in possession of just the same information about the bonds? How about the man who is selling iron and steel, or wire or any one of the staples, where the only thing that determines who shall have the order is the whim of the purchasing agent, coupled rather lightly with confidence that this particular salesman can in some way really give the delivery that he has promised?

There are things which do not come naturally to every salesman alike—things which experience has taught men who have been long on the road. It should always be remembered that selling involves more variables than can be taken care of by a formula. Every customer is a separate problem, and the different moods of each multiply the variables. The goods may be staple, price fluctuations may be slight and far

apart, but the same methods cannot be used with successive customers except by rare chance. And yet there are certain fundamentals which correspond to the harmony of the violinist and the practice which he must give to perfect himself as a professional.

These fundamentals include:

Realization of relations between buyer and seller.
Recognition of things which impel a buyer to buy.
A quick discovery of the mood of the buyer.
Knowledge of the goods offered.
Knowledge of the goods offered by competitors.
In some cases, appreciation of the artistic value of the goods.
In all cases, knowledge of the material value.
Recognition of the time when the buyer has "bought."
Necessity for carrying out the terms of the deal.

Of these, the first is the least well understood. There are times when there is a very distinct "buyers' market" and sometimes the opposite, but a great part of the time what was the buyers' market on one side of the street may readily become a sellers' market on the other. That is, the salesman must distinguish as early as possible in the negotiations whether or not the customer has any good reason for buying at all at that time. Then he can judge for himself whether it is wise to try to secure an order that it is not to the real advantage of the purchaser to give.

This implies that the salesman is familiar with the second fundamental, that is, that he knows what it is that puts the buyer in the market. In the cases of retailers and, of course, jobbers, the reason for their buying is to sell again at a profit. In the case of the ultimate consumer, the reason may not be so evident. The man who comes into a market the last day of October and wants a pumpkin may very likely abhor pumpkin pie, but he may have seven children that all want Jack-O'Lanterns.

The third requisite may seem unteachable, and it may seem that most men are too sensitive to the buyer's mood, but nevertheless it has been known to happen that the salesman made a sale and went away not knowing it, or at least without the written order which he might have had if he had asked for it.

Importance of Knowledge of Product

The fourth and fifth—knowledge of goods offered and those offered by competitors—are the most easily taught of all. The great danger is that the student may become so wrapped up in the technicalities of manufacture that he will forget that the purchaser seldom cares how the goods are made, but only what they will do. The principal object in having a prospective salesman go to the factory is because the testing and inspection of the goods is done there. If he knows just how rigid the tests are, how uniform the accepted product is, and how competing goods have stood the same tests, he is about ready to leave the shop and go see the customer. If he knows just how this thing is machined and that one is treated chemically, he is likely to bore the customer with details with which the latter has no connection and little curiosity.

The next essential, the knowledge of the artistic value, applies to more things that are sold than might at first thought appear. Everything about a building has an artistic value or else it is used to back up something that has. Bricks and stones by themselves have little appeal, but by the time the architect and builder have combined them in a wall which gives the "texture" sought, they most certainly have. I-beams are hardly anything except utilitarian, but they support structures that are highly artistic.

By knowledge of material value is meant that intrinsic value which makes an article a good purchase no matter how the vagaries of fashion and the taste of the times may change. There are always some things that can be depended on never to be so out of fashion as to be unsalable. Whatever the sport models of roadsters may be, there is a certainty that a car modeled on good lines, one which looks right, will also look right some time in the future. When we look back at some of the models that have had a vogue in the past, it is easy to see how much out of the normal some of the attempts at design were, but even in the early stages of development some cars designed by men with ideas of beauty rather than ornamentation are not so far out of date as others.

Of all these essentials, that of knowing when the purchaser has made up his mind to buy is the most elusive. Some read their customers by instinct, some by reason. The salesman who is so full of his selling talk that he must tell it all to everybody, passes signals with abandon, and is very likely to talk himself out of a sale after having had the order in his grasp. A method of approach which allows of frequent questions, not demanding a decision but permitting it, is a good way to avoid going on for very long after the sale has been made. In fact, the best salesmen I have met have been men who let the customer do most of the talking. Why make any great effort to sell the man who sells himself?

Of course, it is pretty good salesmanship that leads a customer to do the talking. A model set on his desk with hardly a word of explanation is apt to set him going. A chart which catches his eye and challenges his preconceived ideas, a photostat copy of a contract or a check from some friend or competitor, these things are worth hours of talk, and yet most of the salesmen I have met have tried to talk me down with a prepared story—most of them with a story that includes attempts to make me answer questions about details of the sale, thus leading me up to the point where, in order to be consistent, I will have to order. This method leaves a bad taste after the purchase is made, and does not help make future sales.

The last item seems superfluous, and it would be but for the fact that a salesman is so likely to look on making the sale as the whole job. His firm sees each sale in terms of goods delivered, accepted, paid for, and as an advertisement to help secure the next order. Of these things the first sale bears the relation of the first egg to a whole flock of hens. Good for a start, but disappointing if the hens won't lay.

Cost Accounting Increases Profits*

By G. M. PELTON

Comptroller's Office, Swift and Company

INDUSTRY always has needed and today needs more than ever before, a strong linking between the accounting and all the administrative departments, that is, those departments which are responsible for the operating, merchandising, and general financial functions of the business.

In the past, business men have frequently been justified in criticizing some accountants for inadequate service. In many cases accountants have not only failed to give proper routine accounting information, but have overlooked a larger opportunity to render adequate analytical accounting service from a broad business standpoint. In other words, they have frequently failed to make their accounting, particularly the analytical service, fit in with the practical administrative requirements of the business.

The line between profit and no profit is narrow today when business is sensitive to changes and subject to attacks from competition. Recognizing this situation, Mr. Pelton emphasizes that cost accounting should be a service to aid in operation. He gives the elements of a departmental statement on financial, manufacturing and merchandising costs, declaring that both accountants and executives should understand the problems of the other group and co-operate for the best final results.

If accounting is to be most effective, it must meet the practical requirements of business and industry from a technical routine standpoint, and also from a broad business standpoint. That is, the records, reports and analyses should be prepared to meet readily the needs of employees directly engaged in buying, manufacturing, and selling activities, and also the needs of general executives who are responsible for the financial and general administrative affairs of the company. It is the duty of the accountant to determine what kind of information is required in each case, and to furnish it in the best possible manner.

On the other hand, it is equally as important that the executives who are directly responsible for the operation and administration of the business should accept, know the meaning of, and make proper use of the accounting information and analyses supplied to them. Accounting is a constructive business service, a profit-making service, and the business man should realize his money's worth from it. To make this possible, there must be more co-operation between accountants and business executives, and less of the attitude of many executives that accounting is a dead expense.

Viewing a competitive industrial organization in its relation to the outside world, we find it is continuously subjected to various economic, physical, political, and social forces over which it has very little or, in many instances, no control. It buys, manufactures, and sells its products or services in an open market in competition with many other organizations working under similar conditions. The law of supply and demand determines what may be obtained for its products or services, many of the requirements to be met in preparing them for market, and the constant changes that must be made in business and accounting methods to meet these requirements. That is, the demands made upon business are involved, and are constantly changing. Consequently, the accounting and business methods should be constantly adjusted to meet these changes. Just because certain methods were proper and efficient last year, last month, or yesterday, is no proof, necessarily, that they meet business requirements this year, this month or today. Business is keenly sensitive and is in a constant state of flux and change. For this reason business and accounting methods and services should change accordingly.

Because of these conditions, accountants are offered greater opportunities than ever before to render real service to business, particularly constructive profit-making and loss-reducing analytical service, that will help executives properly to manage their affairs. Furthermore, this service should not be post-mortem in nature, but should be up-to-date, and help to point the way toward better management and improved results. In the past, accountants have been invited to attend too many business post-mortems, and have not been present at enough meetings in diagnosis and treatment of the business patient. Of course, accounting does not offer a solution to all the troubles in business and industry. But, if properly used, it is an important factor in helping to avoid and eliminate mistakes and losses that otherwise might occur, and to make profits that otherwise might be overlooked.

The Three Functional Services of Accounting

As previously explained, accounting should render both a routine and an analytical service from the following standpoints:

1. General, financial and administrative.
2. Merchandising, that is, buying and selling.
3. Operating, that is, manufacturing and distribution.

* Developed from an address given to the Southern Division of the Illinois Manufacturers' Association.

In the financing and managing of a business, the following primary factors, among others, have to be considered:

(*a*) That the stockholders or proprietors invest their money in the capital stock of the company for the purpose of obtaining a fair return on their capital invested. This return is represented by the dividends paid on the capital stock issued, and must be paid out of surplus net profits earned.

(*b*) The bondholders invest their money in bonds issued by the company for the purpose of obtaining interest on the money loaned by them. Similarly, the holders of current notes payable are entitled to interest, which the company must pay promptly.

(*c*) The money invested in working capital, such as accounts, inventories, etc., and in fixed properties, or any other asset, should work rapidly and efficiently. For instance, the investment in accounts receivable should be collected promptly and with a minimum loss, so it may be again used in inventories, etc. In all cases, however, whether this money is used in working capital or fixed properties, its investment must be justified first of all, and secondly it should be used efficiently and economically after its investment.

The point is that capital costs its hire in the shape of interest and general financial expenses on borrowed funds and profits due to the stockholders. Fundamentally then, there are two important problems to be considered in connection with capital:

1. It should be obtained as economically as possible, both as to amount and cost.
2. Proper use should be made of the capital obtained.

The treasurer is primarily responsible for the financing of the company, that is, for securing sufficient funds to meet the capital requirements of the various activities of a business. Naturally the treasurer and financial executives need to follow all trends in the business, and be fully informed of all changes which occur, why additional funds are necessary, their cost and for what purpose they are to be used. The secret of successful financing is to use the least possible capital consistent with properly financing and conducting a business. Idle capital is a burden. It produces interest costs and overhead expenses for which no value is received. This emphasizes the importance of reducing borrowing to a minimum, keeping cash and bank balances as low as is consistently possible, and of securing a rapid turnover on all capital employed.

Responsibility of Merchandising and Operating Executives

Making economical and efficient use of capital is a direct responsibility of the merchandising and operating executives. Each plant, each branch and each department is in reality a separate business. Each uses its own capital in the shape of accounts, inventories, fixed properties, etc., and each has its own organization. Therefore, each should be fully and finally accounted for, and should appreciate the fact that financial costs are just as much of a burden to business as are merchandising and manufacturing, or operating costs and expenses. Interest on borrowed money, for example, is just as truly a money-out-of-pocket expense as is money paid for wages.

The merchandising success of a business organization is determined primarily by its ability to give satisfactory service and to earn a satisfactory competitive return on the stockholders' or proprietors' investments. Likewise, the final measure of the operating success of a company is its ability to produce quality products at a minimum cost. It is one of the functions of the general management to see that these results are obtained. To accomplish this most satisfactorily it is necessary to give all department heads full and complete cost figures and information covering their operations.

First of all, however, it is necessary to educate them as to the basis on which these figures are determined, their meaning, the system used in accounting for the business, how to analyze the figures, and, most important of all, how to get direct action which will correct errors and produce improved results. In many cases accountants fail to give this service, that is, they fail to prepare proper accounting reports, and to analyze satisfactorily these reports in a simple way, so that they may be understood and be of value to the business man who knows very little, or possibly practically nothing, about accounting. This service is vitally important in present-day administration of business.

Distinction Between Financial Accounting and Cost Accounting

Many business men have an erroneous idea that cost accounting is something very different from general and financial accounting, and that, in a broad sense, it has little, if anything, to do with profit making in the administration of business. Furthermore, they seem to be under the impression that both so-called "cost" and "general financial" accounting are more or less necessary evils to be used in a limited, isolated, and unrelated manner, and that the management should not take them too seriously, because to do so might slow down the business and, proverbially speaking, might develop a condition where the "tail would wag the dog."

As a matter of fact, the writer has failed, so far, to find much, if any, real difference between "cost" and "general financial" costs. They are both costs. He has also been unable to find extreme cases where the accounting had developed to the point that it was the "tail that wagged the dog." He is convinced that from a broad business standpoint, both the so-called "cost" and "general financial" accounting are more or less inter-related and inseparable, and that the most important function of all accounting is to give the management full and complete constructive analytical service which will help to make profits, and prevent

or reduce losses through pre-vision of developments.

It is the function of accounting to give constructive information, which will properly co-ordinate the merchandising, operating, and financial activities, and see to it that no vital factors are overlooked. As previously explained, this service should at all times be constructive and not post-mortem in nature. It is information of this kind that guides the business man in knowing what he can afford to pay for his raw materials, the costs of production and doing business, and the net returns he should realize for his products and services, based on current market prices. But if a business man chronically fails to recognize sound accounting information of this kind, and goes into a competitive market and regularly buys his raw materials and supplies and sells his products and services at prices which do not give him a sufficient spread to cover his total costs of doing business, including a fair return on his invested capital, then his business cannot be successful.

Total Cost of Doing Business

The average business man is keenly interested in the final net profits earned on the invested capital used in his business. He knows that these earnings serve as one of the most important measures of industrial and business efficiency. He also knows that profits and losses represent the difference between the value of products and services sold, and the cost of these products and services, including the total expenses of doing business. Naturally then, if the net results are to be accurately and correctly determined, and are to mean anything, it is necessary in figuring the costs and expenses of doing business, to include all costs and all expenses, that is:

1. The total costs and expenses directly or indirectly incurred in the manufacture or preparation of the products or services sold.
2. All costs and expenses of purchasing raw materials and supplies, and also those incurred in the distribution and sale of the furnished products or services.
3. All general administrative and financial costs and expenses of every kind.

A good many business men fail to consider all of these costs and expenses in determining their final net results. They seem to be under the impression that their business is fundamentally different from other businesses, and that they are justified in disregarding certain items entering into their total cost, particularly when competitive conditions are keen. Frequently they fear that their business is being etherized into a state of inaction through a too comprehensive or technical system of accounting.

A man of this type may be, and usually is, under the impression that he is making a good or fair profit, whereas his profit may be dangerously low or he may be suffering an actual loss. His Profit and Loss and Surplus accounts may show an increase over the previous period or year. But possibly this increase is partly or largely due to certain items of cost and expense, such as depreciation and other items of a similar nature, having been overlooked. Possibly certain expenses have been capitalized instead of having been charged to expense. This emphasizes the need at all times, then, for considering all costs and expenses in determining whether or not sales may be profitably made at certain prices. If more business men will bear this in mind, there will be fewer failures, less business done at a loss, or at such a low margin of profit that it fails to show a proper return on the money used.

As previously explained, the total costs and expenses which should be included in figuring a business are:

1. Buying cost and expenses covering materials and supplies purchased.
2. Operating or manufacturing costs and expenses of all kinds, that is, raw materials and supplies used, as previously explained, and labor and expenses, including proper and consistent charges for depreciation and obsolescence.
3. Financial and administrative costs and expenses including salaries, etc.; interest on borrowed money and write-offs covering financing and refinancing; federal taxes; profits or dividends to proprietors and stockholders; a final balance to be carried to Profit and Loss or Surplus account to help provide for future needs, such as expansion of the business, losses, etc.

What to Include in Total Cost

Naturally, there is a difference of opinion as to whether or not all of the items enumerated above should be considered in determining the total cost of doing business. But suppose you, for example, were to sell your products at a price which failed to cover all of these money-out-of-pocket charges. Suppose you were to sell your products or services on a break-even basis, excluding dividends, or dividends and interest on borrowed money; suppose you failed to include depreciation, administrative expenses, and salaries. Suppose you were to sell your products at enough only to cover plant cost. You might do this, but you would be merely "kidding" yourself, because sooner or later you probably would have to take this money out of your own pocket. Yet this is exactly what is occurring in many business and industrial organizations today.

If you are in a legitimate business, and are giving an economical and competent service to the trade, you should expect your business to return to you its total costs, expenses and a profit. At times, of course, you cannot get this. But that does not justify your disregard of some of these items in figuring the total return to which you are entitled. Instead, irrespective of how your books are kept, this simply argues for keeping all of these charges before you at all times, so you will know exactly what you are doing. Furthermore, from a sound administrative standpoint, you should see to it that this information is kept constantly

before your merchandizing, operating, and other executives. Otherwise they have no way of knowing the full amount of the charges they are expected to meet. Not knowing it, they will not ask it in the sale price and they are unlikely to get it if they do not ask it.

Disregarded Items

As already stated, the inclusion of some of the above items is subject to dispute and is frequently disregarded by business men in figuring total cost of doing business. Some of the more commonly disputed items are: Interest on borrowed money and financing expense; depreciation and obsolescence of properties and equipment, etc.; administrative salaries and expenses; federal taxes; and profits or dividends due to proprietors or stockholders. However, it should be borne in mind that these represent actual money-out-of-pocket expenses that cannot be evaded, and if your sales do not cover them, you will sooner or later have to bear them yourself.

Of course, you will not have to include anything for profit or dividends if you are not expecting any. And if you make no profit you will have no federal income tax to provide for. But most business men expect to make a profit. This does not mean that all of these expenses and charges should be entered and distributed in a formal way in your books of record, although administrative expenses, interest on borrowed money, depreciation and obsolescence, etc., should be handled in this manner. It does mean, however, that all of them, including federal taxes and profits or dividend requirements, should be constantly considered by the management in determining total cost of doing business and, therefore, the prices at which products or services should be bought and sold to produce a satisfactory return to the owners.

Typical Departmental Statement

An excellent example of the value of proper accounting service from a total business cost standpoint may be illustrated by explaining the preparation, analysis and use of a typical departmental statement containing full and complete information covering the financial, manufacturing and merchandising costs and results of a given department. Irrespective of the type of cost finding used, a departmental statement, if properly prepared, should contain information somewhat as follows:

1. A record of the departmental sales, cost of goods sold, and the gross or merchandising profit.
2. Summary figures covering not only the cost of the finished product, but all other costs and expenses, including those of a direct, indirect, fixed property, selling, administrative, financial nature, etc.
3. The final net results of the department before and after deducting operating interest, that is:
   (*a*) Interest paid on borrowed money.
   (*b*) Federal taxes.
   (*c*) Dividends due and payable to stockholders, etc.
4. The amount of capital, such as land, buildings, machinery and equipment, inventories and accounts receivable, used in conducting the business of the department, and the efficiency obtained in its use.
5. Current and accumulative comparisons covering gains, shrinks, yields, costs, expenses, results, turnovers, etc.

In short, a departmental statement of this type is a complete business report covering the combined financial, operating and merchandising transactions of a department. It indicates whether a department is operating efficiently or inefficiently, and what, if anything, should be done to bring about improvement. All of this information is vitally important to the merchandising man who is directly responsible for the results of a given department. Most of it is equally valuable to the operating man directly responsible for production and manufacturing costs. Finally, both the individual departmental statements, and a summary of departmentals covering the business as a whole are of interest and value to general administrative and financial executives. For example, a given department, or line of business may show improper results because of avoidable high costs and expenses, of excessive stocks of goods, and slow turnovers resulting in a minimum number of profits on each dollar used in such stocks, or because of excessive fixed properties, etc. The financial management needs to know, in a general way, and frequently in a very specific way, just what the conditions are, and if the business of a department, or of an entire line of business is being handled as efficiently and as economically as possible.

Basis of Satisfactory Administration

Broadly then, satisfactory business administration, whether or not it is of a single department or of a business as a whole, depends on efficient organization, proper personnel, methods and equipment, satisfactory cost information of all kinds, and economical use of capital. The policies of the company must be sound, the business should benefit from its past experience, it should be wide-awake to the actual conditions and influences affecting it now, and should exercise the keenest judgment possible in forecasting future trends and conditions. It should recognize the need for following closely the changes which are constantly taking place in business and industry—this not only means the changes reflected in the business cycle affecting all business, a single industry, or even a single company, but it also means the changes due to invention, improvements in processing and production methods in general, changes in distribution, or the general plan of doing business, etc. The individual company must recognize these changes and improvements to earn a fair competitive return on its invested capital.

In final analysis both accountants and general executives should recognize and understand the problems and services of the other, and should co-operate in attempting to secure the best possible final results for the company as a whole.

The A. M. A. Annual Convention

Features Discussed Were: Cost and Expense Allocation of Personnel Work—Improvement of Policies—Identity of Personnel Administration and Management

IN the revival of personnel activities since the slump resulting from the business depression of 1920-1922, there has been much speculation as to the direction in which the industrial relations movement was proceeding and much uncertainty as to the theories and practices which would survive the test of practical application year after year in industrial organizations. All observers have realized that swift changes have taken place in managerial thought and action in connection with employee relationships. Ideas and methods once popular have disappeared, and new philosophies are arising to take their place. Problems formerly acute have been solved or temporarily put to one side, and other issues are pressing for attention.

To the observer interested in tracing the trends in industrial relations, much food for thought was furnished at the annual convention of the American Management Association held in New York, January 28, 29 and 30. From the papers and discussions at this convention, the size and character of the attendance, and the informal conferences in corridors and anterooms, it was possible to chart some of the paths along which are moving the philosophies and practices of the leaders in personnel administration.

Identity of Personnel Administration With Management

Responsible executives drawn from all departments of industry were represented to perhaps a greater extent than at any similar convention in the past. The presence of these executives and their active participation in the program emphasized the growing tendency to consider personnel administration as a definite function of management. Operating officials are coming to look upon the industrial relations expert as a staff specialist employed to help them solve problems which they now acknowledge as being directly hooked up with their own jobs. Personnel directors and counsellors, on their side, have made impressive advances in mastering the essentials of economics, of business management, and of finance. The co-operation and mutual understanding which have resulted from this state of affairs have worked to the advantage of all parties in industry.

Along with this recognition of labor administration as an essential part of general management, there is growing up—gradually, it is true—a policy of giving unified consideration to all subjects having a bearing on labor relationships. The sales manager no longer ignores conditions of employment in the factory; the financial expert is giving thought to stability of work; the public relations advisor has learned that his efforts are gravely hampered if labor conditions in his organization fail to win public approval.

Increased Recognition of Economics

The American Management Association convention furnished abundant evidence of the increasing emphasis which is being laid upon economic principles. The high ethical basis of enlightened labor administration is unchanged, but the sentimentalism which characterized much of the earlier activities has mainly disappeared. To a constantly increasing extent, policies are being justified by economic arguments. The industrial relations specialist is likely himself to be an economist. He no longer hesitates to face the questions: "What will it cost?" and "Will it pay?" Methods have been developed by which the costs of personnel activities are being measured with fair accuracy. To a considerably less extent the benefits, tangible and intangible, are being estimated and set up as credits.

Along with this progress in economic methods has come the disposition to make practical use of the services of the professional economist. Management engineers no longer rub their eyes when they see the title "economist" in the organization chart of a business institution. An entire session of the recent convention was given over to the subject "The Economist as an Aid to Management."

Putting the Psychologist to Work

The psychologist, no less than the economist, has been drafted into the service of industry. His contributions are becoming more valuable as the years pass, as his science becomes more nearly exact, and as he gains in understanding of the practical problems confronting industrial management. The recent convention was characterized by an unusual degree of attention to psychology, mental tests, and closely allied subjects. One of the most largely attended sessions was devoted to the topic "Limitations in the Use of Psychological Tests." Another session considered "Measuring and Grading Supervisory Forces."

On the latter topic the discussions brought to the surface much earnest thought, but little evidence of unity in opinion. Management is giving increased recognition to the vital importance of the task of selecting supervisors, but agreement upon satisfactory substitutes for the ancient methods of off-hand judgment, of trial and error, and of promotion by seniority

seems from present indications to be a considerable distance in the future.

That elusive element "labor psychology" likewise received its share of attention. Employers have a growing realization of the importance of finding out what the workman is really thinking about and what he wants. In dealing with industrial relations, declared Henry S. Dennison, who presided at the annual dinner, American business is "working with a material, the fundamental nature of which we know almost nothing about." He emphasized the lack of definite understanding about the effects of fear, of fatigue, of economic charges, and of irregularity of work.

An animated session, in a room which proved to be far too small to accommodate the crowd interested in the subject, was given up to discussion of the college graduate in industry. For a good many years American business has been searching for methods of conserving the potential value of the college man and at the same time of giving him specific training which will make that value actual.

The discussion on this subject developed sharp differences of opinion. It was evident that the problem of fitting the college graduate into industry was still far from final solution. It was not less evident, however, that the earnest efforts which are being made by several companies have had definite and satisfactory results. This and the indications of increasing interest were the encouraging points in the session.

One of the most striking things about the convention was the open-mindedness of the attendants and their disposition to attack personnel problems by scientific methods. The man with a "plan" which would solve once and for all every difficulty of labor relationships had stayed at home. While it is true that certain underlying principles—economic, psychological and ethical—are steadily gaining in recognition among advanced labor managers, it is no less true that these principles are understood to be of so general application that they must be used differently in the varying circumstances of actual conditions.

Along with this open-mindedness has come tolerance. The disposition loudly to assert that one practice was absolutely right and that anything at variance with it was everlastingly wrong has largely disappeared.

The Assumption of Fairness

The convention did not re-enact the Golden Rule. The time apparently has passed when personnel administrators believe it necessary to gather in solemn conclaves to convince themselves that they wanted to be decent. In the discussions at the recent meeting the disposition to play fair was generally taken for granted. It was assumed that nearly everybody wants to be fair and that the pressing problem is to perfect policies and methods to carry out this desire. This may be noted as one of the most hopeful tendencies in present-day labor administration. Those who still are unwilling to be fair in their dealings are considered hopelessly out of the race. Efforts of modern personnel activities are devoted mainly to the devising and execution of practical methods by which the square dealing, which everyone concedes to be desirable, may be brought about in ways which will be economically justifiable and scientifically correct.

The Cost of Exact Knowledge

THE Jones Manufacturing Company makes a product that requires periodic chemical analysis which has been made by an outside chemist. One day this chemist was given a sample of a competing product to analyze. Believing his work to be of considerable value, he charged the company $100 for the analysis, which raised such a row that the concern installed its own laboratory.

The chemist placed in charge seemed unable to keep busy at routine work, so everybody hunted other useful things for him to do, with some surprising results. Then he was given an assistant, who failed to keep busy and was given some mechanical testing work. This continued until the laboratory employed some 20 men, cost a lot of money, but could show no balance sheet proof of accomplishment.

About this time the head accountant became convinced that a statistician to standardize and consolidate all company statistics was necessary. This met with little opposition until a man was found who would take the job for the nominal sum of $4500. Another row! No man could possibly be worth that much who merely put together a lot of figures. The result was that no statistician was hired and the laboratory work was decidedly curtailed.

Every business is in a similar position. It must decide what influence the acquirement of exact knowledge shall have on company policies. If anyone is looking for a thrill, let him tell a company that it is losing $50,000 each year through lack of knowledge it could get for $10,000. Some firms heed such statements and profit by them. The majority of them, however, want to know how any outsider presumes to know more about their business than they do.

Later, and when in a quieter frame of mind, they recall the conversation and wonder if there really was any truth in the statement that they were throwing money away foolishly. Without referring to the original source of that information, they consult some other concern. This new consultant is very glad to furnish them with a most wonderful and complicated system for finding out things. It is operated for six months, furnishes very little information of value, and costs a lot. Result—it is kicked out and the company regrets the day it started to believe it was becoming old-fashioned.

The "happy medium" of getting all necessary but no unnecessary information is hard to find. Perhaps some day business colleges will offer the degree of R. S.—Revisor of Systems.

New Cobweb Chart

By WALTER N. POLAKOV
Consulting Engineer

THE accompanying illustration shows a new chart designed to represent graphically a long series of data more clearly and more compactly than is possible by means of ordinary bar or line charts. It is particularly suitable for comparative analysis of data compiled over various periods of time. Relative or absolute increases or decreases are clearly shown, comparison of data for similar periods such as seasonal or daily variations is facilitated, and the trend and rate of progress are plainly evident.

The construction of the chart is clearly shown in the illustration. The field about a point at the center of the chart is divided into as many equal parts as there are periods in the desired cycle. In the example shown, a yearly cycle by months was desired, so 12 radii were drawn. If weekly data were to be plotted, 52 divisions would be made, etc. Upon a radius a scale is laid out suitable for the data to be plotted and con-

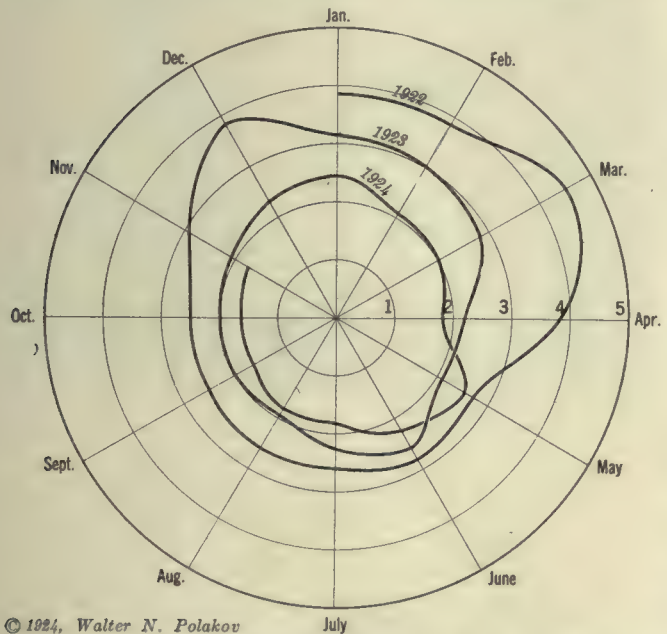


FIG. 1 NEW COBWEB CHART PREPARED FROM SAME DATA AS FIG. 2

centric circles drawn at suitable intervals to facilitate reference to the curve. In Fig. 1 the curve shows the reduction in fuel consumption per unit of production and the scale used is a ratio of pounds of coal per pound of product.

Fig. 1 was constructed from the data used in making Fig. 2, and a comparison of them at once shows the advantages of the cobweb chart. When plotting a single cycle, such as data for 1922, Fig. 1 can be plotted with three times larger scale but in the same space needed for a chart like Fig. 2. If additional cycles are plotted, as in the examples, the cobweb chart requires no additional space, while the bar chart grows larger constantly.

Interpretation of the data shown by the cobweb chart is easy. The trend of the curve is unmistakable. Comparisons of similar periods in different cycles are made readily. Because of its compactness, a cobweb chart showing data for a long period of time can be read much more quickly and accurately than is possible by other means. To get the mean or average of a period studied, a circular planimeter, similar to those

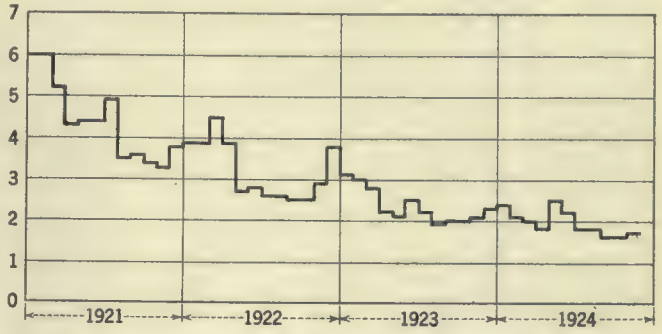


FIG. 2 COMPARATIVE CHART SHOWING IMPROVEMENT IN AMOUNT OF COAL USED PER UNIT OF PRODUCTION

used for calculating records on instrument charts, can be used.

Logarithmic scales can be used in graduating the radii, so that the chart can be used to present the same kind of data for which usual semi-logarithmic charts are most suitable. By the use of logarithmic graduations it is possible to show in a small, compact chart, data covering long periods of time and containing considerable variation.

Specifying Screw Threads When Purchasing

By A. L. GREENE
Buffalo Belt Co.

THERE is considerable waste in industry caused by the lack of information on the part of manufacturers about the detail items used in their product. Because of this ignorance, an expensive type of accessory may be specified or purchased when a cheaper type would serve just as well and often even better.

An example of this is the prevalent habit of specifying "V" threads on bolts and nuts when U. S. Standard threads would usually give equivalent service at considerably less expense, and in many cases are to be preferred to V threads from an engineering standpoint. A brief review of the factors influencing the choice of thread should be of some practical value to manufacturers.

The V thread, as its name implies, is made in the form of a letter V—that is, with a pointed top and bottom bearing surface. The U. S. Standard thread has the same pitch diameter as the V thread but the tops and bottoms of the threads are slightly flattened. This slight variation in design, while limiting its use in a few industries, has reduced by an appreciable amount the cost of manufacturing the U. S. thread.

In boiler manufacturing and similar industries where airtight or watertight fits are essential, the V thread

is, of course, the logical one to use. The character of this thread is such that the fit between the bolt and nut threads, provided tolerance limits have been gaged correctly, constitutes a solid bearing surface not only on the sides but on the top and bottom as well.

Usually, however, airtight or watertight fits are not essential. The principal requirement demanded of the average bolt and nut is that they have a perfect angular bearing surface in order to prevent stripping and permit the nut to be tightened. The U. S. Standard thread meets these requirements as well as the V thread. Factors which make the U. S. thread more advantageous are that the flat surface of the U. S. thread eliminates the dangers of stripping associated with pointed surfaces; the flat surface offers no central point for the start of a fracture; and the U. S. thread has a greater root diameter, thus giving greater strength.

Taps or dies used in making V threads wear out much quicker than those used for U. S. threads because of the sharp points maintained on the former. Since progressive bolt and nut manufacturers maintain very fine limits on their threads to insure proper fit, after relatively few operations the sharp surfaced tools used in making V threads are discarded. Taps and dies are expensive and the great number necessary in manufacturing V threaded bolts and nuts increases materially the finished cost over that of similar items U. S. Standard threaded.

Because of these factors, attention should be given to every purchase requisition which calls for V threads. In but few instances will their increased cost be justified, and by specifying U. S. Standard thread instead, a considerable saving in material cost is possible.

Better Packaging Methods

PACKAGING methods have been greatly improved during the past few years, but there are few concerns that cannot still improve their containers, usually benefiting both themselves and their customers. Probably the principal reason why further improvements are not made is that suggested changes appear to be of too little importance to bother with. But somebody—was it Benjamin Franklin?—has truthfully said that the man who made a small change in his business each day would find his business revolutionized in a year's time.

FIG. 1 BALANCE SCALE FOR WEIGHING BOLTS

Results made possible by noticing the little things are shown by the experience of the Buffalo Bolt Company. For many years it had been their practice, in filling a package supposed to contain a specified number of bolts, to count each bolt. Obviously this was a slow and tedious process which made packing operations expensive.

FIG. 2 STITCHING CARTONS BY MACHINE

Now all packages containing bolts of all kinds up to 2 in. long are counted by weight. In making up the weight for a specified package, an operator carefully counts two packages, putting, for example, 50 bolts in each. These packages are weighed on a balance scale (Fig. 1), and if they weigh the same, denoting an equal number of bolts in each, their weight is used as a standard for making up similar packages in the future.

By this method the output of the packing department has been increased 75 per cent, surely a worthwhile improvement when made possible by so simple a change in procedure.

Another improvement made in the packing methods of this company was the way in which packages were constructed. Formerly the ordinary type of folded cartons were used, but considerable trouble was experienced by reason of breakage during shipment. With the idea of eliminating this trouble, a small stitching machine shown in Fig. 2 was installed, and cartons were stitched instead of folded. This machine, with

one operator, stitches all the cartons used. Not only is the new carton stronger, but it can be produced much faster and cheaper than the kind formerly used.

Many of the smaller-sized bolts were often packed in paper packages. It was the former custom to tie these packages with cord as shown at the right in Fig. 3. Broken packages often resulted, however, because of the tendency of persons handling them to carry them by the cord. To overcome this tendency, a paper strip was pasted around the package in place of the cord. Besides preventing breakage, a much neater package was secured and the output greatly increased, in some instances almost doubled.

In these three instances a better product has been

FIG. 3 OLD AND NEW WAY OF FASTENING PACKAGES

secured both from the manufacturer's and the customer's viewpoint, and production has been increased with attendant reductions in cost. All this has been accomplished without large outlay of money for new machinery. In fact, nearly all packaging improvements are based principally upon observation, analysis of existing defects, and common sense, and very little upon capital expenditure.

Savings by Electric Annealing

TOTAL savings in operation amounting to 74 per cent resulted from the installation of an electric furnace by the Nutting Manufacturing Company for annealing shells. This company manufactures a large number of small brass, steel, and aluminum punchings used by manufacturers of automobile tail lights. A G. E. type electric furnace was installed by the company in January 1924 to supersede a gas furnace which had previously been used for this purpose. It was found that the electric furnace required, on a typical job, but one hour's labor as against 14 for the gas furnace. The actual cost was 50 cents as against $7, a saving of $6.50, or 93 per cent in labor cost in favor of the electric furnace. The cost of electricity was $3.15 on the particular job in question, as against $7 for gas with the old type furnace. A 55 per cent saving in cost of fuel was thus effected, making a combined saving of $10.35, or 74 per cent.

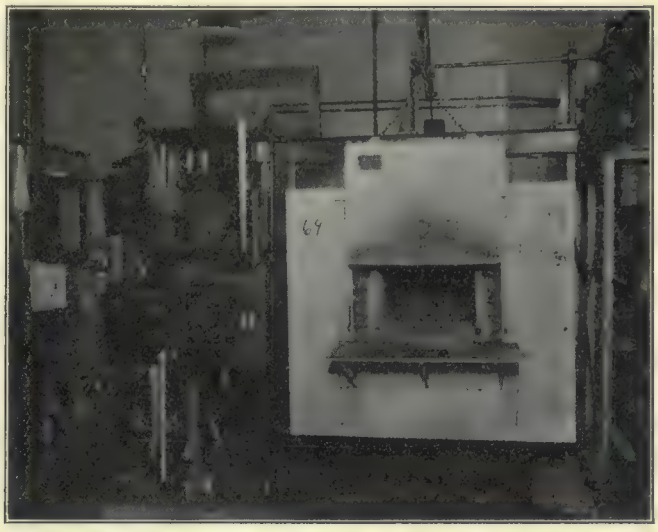


FIG. 1 DIRECT HEAT FURNACE WITH AUTOMATIC TEMPERATURE CONTROL

The annealing, according to the company officials, is now more uniform, resulting in less rejection. Pitting is done away with, giving a lower cost of nickel-plating. Variations in temperatures obtained run from 350 deg. fahr. for drawing aluminum to 1500 deg. fahr. for heat-treating dies.

Handy Holder for Daily Time Cards

THE accompanying photo shows a very handy holder for daily time cards which is giving excellent results as it keeps the cards clean and holds the time cards according to the day of the month. As shown in the photo, the cards are numbered in red ink to correspond with the days of the month, the cards

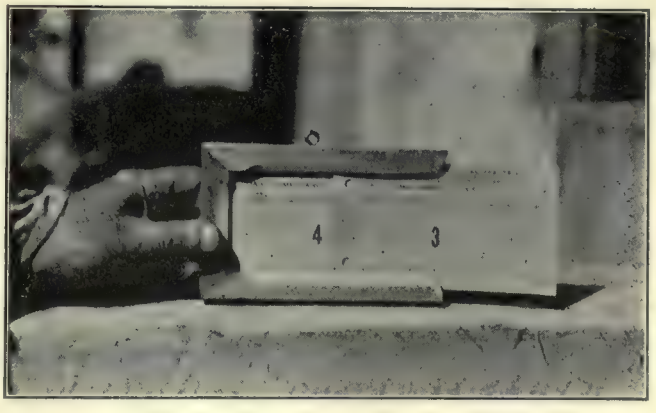


FIG. 1 HOLDER FOR DAILY TIME CARDS

being placed in the holder numerically, the one for the first of the month being placed on the outside of the pack of cards. This makes it unnecessary for the workmen to look at the calendar to check up the date of the month.

The holder was designed by a workman in the machine shops of the Fire Department of the city of San Francisco.

THE EDITORS' PAGE

Management Pioneers

THE article by E. W. Rice, Jr., which appears in this issue, contains some very interesting information, and much that will be new to many of our readers.

Although Dr. Taylor had been developing principles and methods of scientific management for some 20 years previous, the 1903 annual meeting of the A. S. M. E. was the scene of the first convincing, public suggestion that it might be both possible and profitable to apply engineering methods to factory operation.

Before this memorable paper was presented by Dr. Taylor, and while he was still developing his ideas, the General Electric Company, or, rather, its predecessor, the Thomson-Houston Company, was working out its production problems from a similar, scientific point of view. Functionalization was the first step accomplished and, in this departure from accustomed procedure, agreed with one of the main themes of Dr. Taylor's philosophy of management.

Following this came the development of a scientific method of estimating the factory costs. This accomplishment, taking place as it did in the 80's, at least 20 years before cost finding or standard costs were generally considered valuable management aids, was in itself a real achievement. When, in addition, one learns that 35 years' progress in management knowledge has necessitated changes in the operating details but none in the underlying principles involved, this pioneering development is seen in a still more favorable light. Included in the plan for estimating costs was a method by which expense items could be equitably allocated to the various products. The general scheme then involved is still functioning satisfactorily.

In those early days *caveat emptor* was the rule for business conduct rather than the exception, as it is at present. The General Electric Company was one of the first to substitute for this attitude a "spirit of scientific service to the customer."

It is interesting to speculate on what proportion of the success attained by the General Electric Company has been due to this early application of scientific methods in seeking solutions for manufacturing problems.

The New Ford Laboratory

EVERY organization, to continue successful, must keep not merely abreast but ahead of the times. Moreover, human progress and economic growth depend largely on this planning for the future. Industry and science must take the lead, as always, in research and experimental work if the world is to move on.

The new Ford industrial laboratory, described elsewhere in this number, is the latest contribution to advancement in the practical arts. The inscription above the entrance dedicates it to this service: "Mankind passes from the old to the new on a human bridge formed by those who labor in the three principal arts—Agriculture—Manufacture—Transportation."

Back of the laboratory is a sound business policy. Its main activities will be devoted to the products of the Ford industries, which cover all three fields included in the above inscription. But the idea is not to change the basic design of cars, trucks and tractors and so make those already in the hands of purchasers obsolete before use has worn them out. The plan is just the reverse—to find means of utilizing better methods and materials, so that the customer will get more for his money, and the machine he buys will last longer and give him greater service.

Therefore, the laboratory has a significance to industry at large and to society, in addition to what it will mean to the Ford plants. Conservation of materials and energy, the prevention rather than the reclamation of waste, are its objects. The facts discovered and the lessons learned, generously passed along to others struggling with similar problems, will be of inestimable value in furthering the progress of American industry.

$600,000,000 Saved per Year

THE result of the efforts to eliminate waste in American industry is a saving which exceeds $600,000,000 per annum. Such is the declaration of Secretary Hoover, made at the recent annual meeting of the American Engineering Council. As indicating how some of this great saving has been brought about, he gave this instance:

> We have at least three standards of lumber that are in use in a large part of our distribution system. They have been accomplished by voluntary means and not by legislation, and the lumber industry itself estimates that the savings to the producer, the distributor and the consumer already exceeds $200,000,000 a year by the establishment of those standards.

It is not to be wondered at that those industries which have been benefited and that appreciate the possibilities of waste elimination are heartily supporting the program. On this point Mr. Hoover ventured to say:

> It is a curious fact in that relation that, were it possible under our form of government to recruit money by public subscription for the expense and continuation of that work, there would be no difficulty in raising from one to five millions of dollars per annum from the trades themselves.

This work in which manufacturers are so much interested, and which has brought such substantial savings, includes "the establishment of standards, the economies which they bring in production and distribution; the

elimination of unnecessary varieties, the establishment of specifications, the vast improvement in our statistical services and the stability they give to business."

Turning to the origination of the movement, Mr. Hoover in generous measure extended appreciation to the American Engineering Council for its contribution to the public welfare in the report on "Waste in Industry," saying:

> It is at least a tribute to this organization that it should have launched a campaign four years ago that has come to have such a general acceptance and general respect throughout our industries and trades that the Department of Commerce is totally unable to accommodate the demands made upon it, and today we are asking industries to delay their conferences and their programs for three or four months ahead in order that we may get to them.

Seldom do we have a great economic and industrial movement evaluated so quickly and in such a quantitative way. It is a certainty today that elimination of waste is, in itself, an asset and in no sense a liability. To the manufacturer it means greater economy and lessened cost in production and distribution. To the worker it means more certain employment because of the increased stability of the industry from which he gains his livelihood. To the public it means a reduction in the cost of living on the one hand and an increase of the standards of living on the other.

Simple self-interest demands that the efforts to eliminate waste should have complete support, not only through the work conducted by the Department of Commerce and manufacturers' associations, but also within the individual plant. A way has been demonstrated to save and to reduce costs not only in production but also in the less developed but quite as important work of distributing manufactured products.

Industrial Budgeting in 1925

WITH an increase of knowledge as to the possibilities of budgeting, it is now fully appreciated that as a mechanism it is concerned with far more than gathering financial data. In truth, budget methods and budget administration are the foundation of the scientific control of the financial affairs of a manufacturing company. The real purpose is to plan future operation and to establish means whereby management may be assured that performance will correspond with plan. It is doubtful if any other mechanism or device of management has drawn to itself such immediate approval and wide acceptance as the budget. This is proof of the value of the results which it can bring; the benefits and advantages of industrial budgeting need no renewed emphasis.

It is a source of gratification to MANAGEMENT AND ADMINISTRATION that, through its pages and the efforts of the organization behind the magazine, much of the worth-while literature of budgeting has been made possible. In all, through this source some 25 articles and 10 books have been published, dealing wholly or in part with budgeting, its methods, applications, possibilities and results—these constitute a library of working information in themselves, a great aid to the operating executive.

The interest which is evident today shows that budgeting is destined to increase widely in application and use during 1925. This is a happy situation, for better answers will be given to the questions: What shall we spend and what will be the result? What profit shall we make from the operations of the current year? What will be the position of our company on January 1, 1926?

As for by-products secured along the way, these budgeting applications will establish responsibility and fix accountability of all acts of operation; will formulate general policies; translate them into plans for action; and develop detailed decisions, orders and instructions for carrying these plans through to completion. Rather more broadly stated, during 1925 American manufacturers will know more of what they are doing and the probable and possible results of their operations than they have in any preceding year. This will be the natural result of the scientific attack through budgeting upon the great problem of financial management.

Eliminating the Box to Increase Sales

A REMARKABLE opportunity to cut out a useless expense totaling at least $13,500,000 annually, and thereby reduce the selling price of products and increase sales considerably, is explained in an article on "Getting Rid of the Export Box," by George F. Bauer, appearing on page 241 of this issue. Mr. Bauer outlines the method already in effect on the Great Lakes and on the Ward Line steamships, whereby automobiles are shipped completely assembled. On the inland waterways no protection is needed. For ocean transport, the cars are merely set on individual platforms before being hoisted on board, and covered with tarpaulins to prevent injury to the finish.

Knowing that all crating is a dead loss which adds an average of $65, or 13 per cent, to the selling price abroad of a $500 car, and thereby puts this car beyond the reach of a larger number of potential purchasers, the National Automobile Chamber of Commerce is endeavoring to persuade all automotive manufacturers, railroads and steamship lines to co-operate in eliminating this waste. It can be done, because it has been done in some cases, and no injury to the cars has resulted.

Everybody benefits. The customer is saved $65; many more cars are sold; consequently the dealer and the manufacturer make more profit; and, at the same freight charge per car, both the railroads and the steamship companies increase their revenue. Lumber is conserved and men are released for production.

Manufacturers of agricultural machinery and a host of other products are directly concerned in this possible saving in their own lines of activity, and the National Automobile Chamber of Commerce will welcome both suggestions and co-operation from these many sources to help solve the problems involved. The steamship companies and railroads are especially urged to aid, as the success of the plan depends upon their co-operation.

INDUSTRIAL EQUIPMENT
NEWS FOR THE MANAGEMENT

This department is conducted to give our readers essential facts regarding items of industrial equipment recently placed on the market, that may be used to increase production or lower costs. The editors will be glad to furnish additional information about any item. All information given is obtained from reputable manufacturers, and MANAGEMENT AND ADMINISTRATION accepts it as reliable.

Speed Transformers

FOR use on all industrial machinery calling for change of speed are the two reduction gears being marketed by

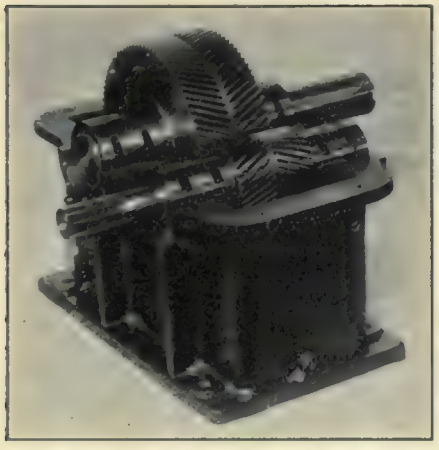


FIG. 1 TYPE H SPEED TRANSFORMER

Poole Engineering and Machine Company. Type H (Fig. 1) consists of a double helical or herring-bone forged-steel gear and herring-bone pinion cut integral with shaft of chrome vanadium steel. Gear and pinions are totally enclosed in cast-iron casing having ground and oil-tight joints. Bearings are babbitt-metal lined, cast-iron shells and are removable. Lubrication for low-speed drives is obtained by a splash and gravity system, for turbine and other high-speed drives an oil pump and cooler is provided.

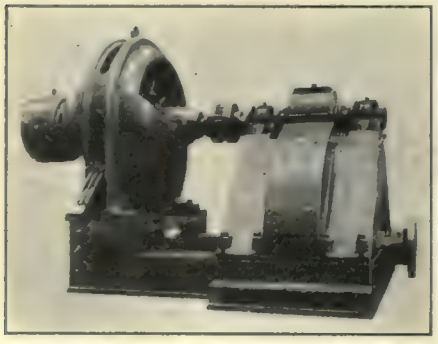


FIG. 2 TYPE K REDUCTION GEAR

Type K reduction gear (Fig. 2) consists of a cast-steel double helical gear and a forged-steel pinion integral with shaft. Both gear and pinion have cut stub teeth. Shafts are mounted in babbitted bearings of the ring oiling type. Gear and pinion run in oil-tight case and are lubricated by splash system. The high-speed shaft is located at the top of the casing and the driven shaft directly beneath it near the floor line.

Electric Furnace Element

TO enable manufacturers to obtain the benefits of electrical heat for carburizing and heat treating of steel, vitreous enameling, firing abrasive, wheels, heating lead baths, cyanide pots, salt baths and for other industrial processes requiring heat up to 1850 deg. fahr., Westinghouse Electric and Manufacturing Company has developed a unit type electric furnace element.

The elements can be mounted on the walls, roof, or floor of the furnace, in single or double banks so that with the many standard ratings and lengths available, a wide range of heating capacity can be secured. The elements consist of nickel-chromium rods formed into a reverse bend type coil. They are supported at intervals of about 12 in. along their length by refractory cleats which are held in place between T-shaped bricks of standard size imbedded in the furnace walls.

INSTALLATION OF ELECTRIC FURNACE ELEMENTS

Coil ends are connected by Oxide connectors, another new Westinghouse product which secures a strong, highly conductive joint without the necessity of welding. Automatic control can be applied with the elements.

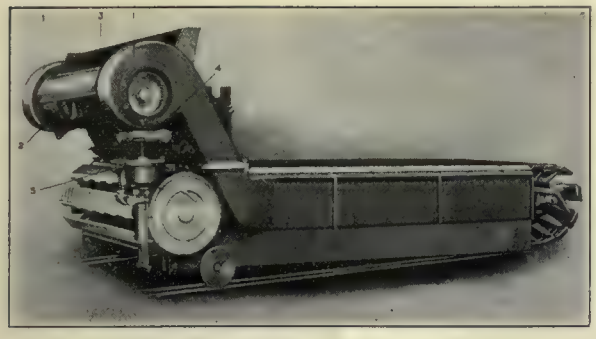
Traveling Grate Stoker

A SELF-CONTAINED, forced-draft, traveling grate stoker, by means of which low-capacity natural draft furnace installations can be changed into high-capacity units, is being marketed by Combustion Engineering Company. Forced draft has a number of advantages over natural draft, but its application to existing plants usually requires extensive and expensive reconstruction of the furnaces.

This self-contained stoker can be installed with little trouble, and all the machinery of fans, shafting, and mechanical connections to the stoker are brought together in one unit. It can be removed from the furnace without having first to break joints with an air duct or disconnect any driving mechanism. Frequently by using these units to change one or more boilers to forced draft, additional boilers are made unnecessary. High ratings can be carried with low-grade coal and sudden peak loads can be more easily met since the fireman has a unit to "step on" when steam is low.

The stoker is adaptable to many kinds of fuels, including non-coking bituminous coals, all grades of anthracite, coke breeze, and lignites. It may be applied to boilers of all sizes and types, but is especially suitable for boilers up to 600 hp.

The forced-draft fans are mounted on the stoker frame and are driven by the same motor that operates the stoker. Forced-draft ducts extend along the side frames, and air is admitted to the under side of the grate surface by a damper mechanism which graduates the supply from the front to the rear of the grate. The grate is composed of a series of box-shaped, sectional fire bars mounted upon chains which engage the sprocket wheels.



TRAVELING GRATE STOKER

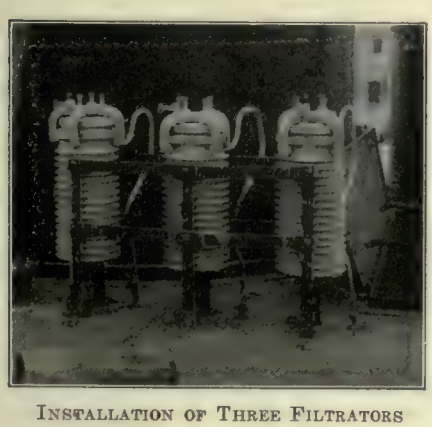
An advantage of such a self-contained unit is that it can be completely assembled and tested before shipment. This is not possible where separate fans and driving mechanisms are used. Preparation of foundations is simplified, and the setting is no more complicated than that of a natural-draft stoker since the designer is not concerned with the location of shafting and motors.

Many installations of this type stoker have been made in Europe but it is just being introduced into this country.

Boiler Scale Eliminator

THE Filtrator is a device designed to prevent formation of scale on boiler surfaces, to remove, gradually, existing scale, to prevent pitting and corrosion, and to counteract harmful effect of lubricating oil getting into the boiler. Its installation is simple, its upkeep cost is low, and it is harmless to boiler and fittings.

The operation of the device is mechanical, so that satisfactory results can be obtained with any kind of feed water, and its action is constant. A perforated cylinder is filled with ordinary flaxseed and is encased in a cast-iron cylinder.



INSTALLATION OF THREE FILTRATORS

Live steam from the boiler is piped directly into the Filtrator, permeates the flaxseed, extracts from it a mucilage, and condenses and produces the Filtrator Emulsion. This emulsion descends by gravity into the boiler and is thoroughly mixed with the feed water. Each particle of hard matter suspended in the water, as well as the sides of the boiler, is coated with a thin film of the emulsion. This prevents the particles from adhering to the boiler and forming scale but they are gradually settled and ejected from the boiler in regular blowdowns.

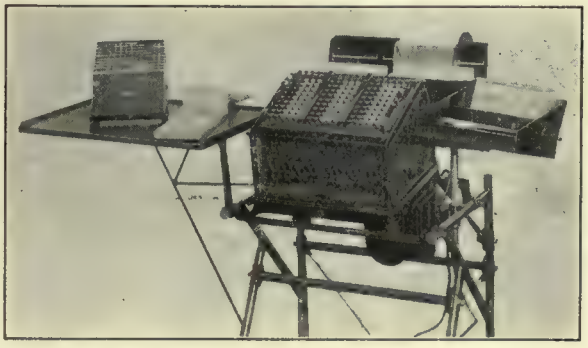
The emulsion also absorbs any acids contained in the water, thus preventing pitting and corrosion, as well as any lubricating oil that may find its way into the boiler. Practically the only upkeep expense of the device is an occasional recharge of flaxseed which, at present, is readily obtainable at seven cents the pound. This device is being marketed by Filtrators Company.

Form Holder for Pay-Roll Machine

AN auxiliary device for holding bills or checks has been developed to facilitate operation of the pay-roll machine, described in the September issue of MANAGEMENT AND ADMINISTRATION, by which pay-check, pay-check stub, pay-roll, and individual pay-record card can be written at one operation.

The holder can be attached to either side of the machine and is adjustable as to distance from front of the machine, height, tilt, and angle. It is divided into three sections. The rear section is for addressed bills or checks ready to be completed on the machine, the front section is for completed forms, and a section at the bottom holds blanks. The rear section is so constructed that it "feathers" forms placed in it to make handling easier. Two sizes, 13¼ in. and 17¼ in. long, are available; each is equipped with a sponge cup.

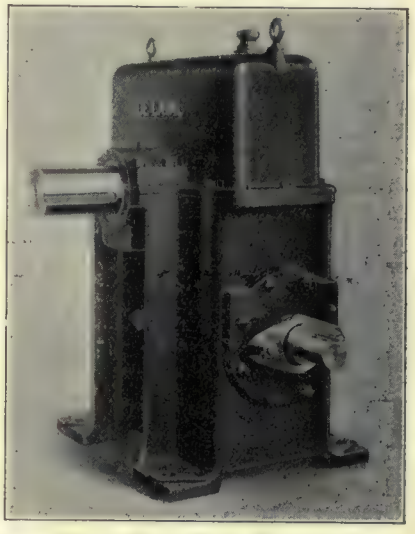
This device is manufactured by Burroughs Adding Machine Company.



FORM HOLDER FOR PAY-ROLL MACHINE

Worm Gear Speed Reducer

IN using alternating current electric motors to drive industrial machinery some kind of speed transforming device is nearly always necessary, since efficient motor speeds are considerably greater than usual machine speeds. Worm gears provide one method of transforming speeds and the De Laval Steam Turbine Company has developed a gear that

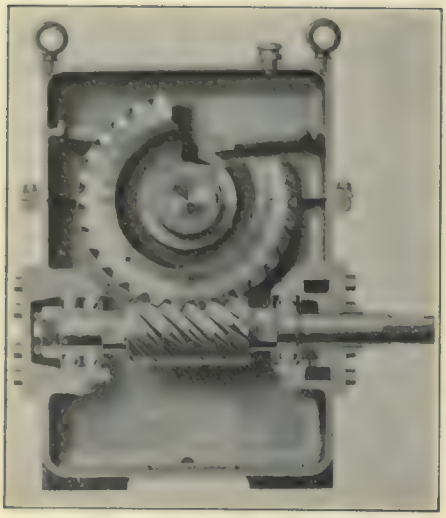


WORM GEAR SPEED REDUCER

combines noiseless operation, compactness, and reliability, and which is applicable to motors and turbines driving such machinery as rotary kilns and coolers, tumbling barrels, agitators, mixers, driers, mills, calenders, machine tools, stokers, transfer rolls, fans, elevators and conveyors of all types.

Gear teeth are designed to combine a minimum of sliding and a maximum of rolling action between the worm and gear. Undercutting is avoided by making the included tooth angle about 60 deg. Three or more teeth are always in contact, resulting in a smooth flow of power, elimination of noise and vibration, and decreased wear of gearing and bearings.

The reduction is enclosed in a dust- and moisture-proof casing. Worm and gear are lubricated by splash system. The worm is made from low carbon alloy steel forging which is carburized and heat-treated after



CUT-AWAY VIEW OF REDUCER

threads are cut. Wheels are cast phosphor bronze having low coefficient of friction and high tensile strength.

Reduction gears are made for transmission ratios from 4 to 1 up to 100 to 1 in one step and for higher ratios with double reductions. Power is delivered at right angles to the motor shaft.

Electric CO_2 Meter

FOR more efficient power-plant operation, made possible by accurate knowledge of combustion conditions, The Brown Instrument Company has developed an electric CO_2 meter for measuring the percentage of CO_2 in flue gas. The manufacturers claim that an average installation will respond to a change in per cent of CO_2 in 45 seconds with an accuracy of ½ per cent. It is both indicating and recording, and furnishes a record of flue-gas temperatures as well as CO_2 percentage.

CO_2 METER, FLUE GAS PYROMETER AND SWITCHBOARD

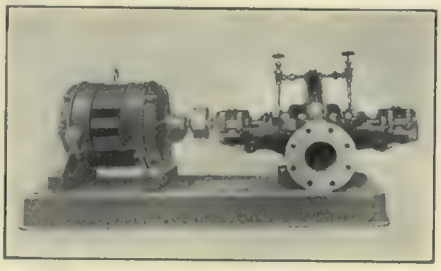
The instrument works on the principle that CO_2 conducts heat at a different rate than air. Variation in temperature affects the resistance of two wires, one surrounded by flue gas and the other by air, and a millivoltmeter

INSTALLATION OF CO_2 RECORDER

graduated in per cent CO_2 shows the unbalancing of a Wheatstone bridge with which the wires are connected. No chemicals, solutions, glass, rubber parts, or levers are used, and the equipment is designed to withstand the hard usage and dirt of the average boiler-room.

Centrifugal Pumps

A SMALL centrifugal, double suction pump designed for simplicity and ruggedness has been developed by The Wilson-Snyder Manufacturing Company. Construction has been simplified so that emergency repairs can be made

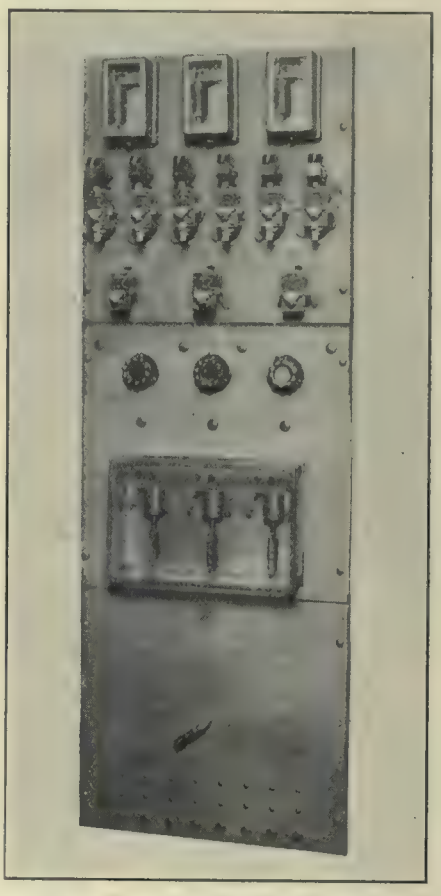


CENTRIFUGAL PUMP

in a machine shop. The pump operates with Westinghouse motors for either AC or DC current.

Electrode Control

CLOSER and more flexible control, with simpler operation, for industrial electric arc furnaces used for heat treating, melting and smelting various materials and similar service is the purpose of the automatic electrode control equipment being sold by General Electric Company. This equipment decreases the time interval between any change in current and the functioning of the apparatus to overcome the change, thus



ARC FURNACE CONTROL PANEL

permitting a more nearly constant current and heat to be maintained.

The dynamic braking circuit is completed in a shorter interval of time after power is removed from the motor to decrease electrodes over travel. Bearings or parts subject to wear have been eliminated. Three types of regulators are included in the line, for use with one, two and three electrode equipment, and for which an auxiliary control panel is required. The auxiliary control is provided with a push button station giving individual control of each electrode.

Chip Separator

THE F. C. Sanford Manufacturing Company has developed a chip separator for use in combination with an oil separator for separating chips from finished pieces after the oil has been extracted from both work and chips. The work box is designed to hold a full load from the oil separator

CHIP SEPARATOR

pan, and the chip separator dumps its load after separating.

The shaker box is 24 in. square and 6 in. deep. The connecting rod to the tight and loose pulleys is provided with a quick connection bolt, by which it can be quickly attached to the box after dumping. Three screens having ¼, ½ and ¾ in. mesh are furnished. Ample room is provided beneath the box for a container to catch the chips.

Industrial Heating Equipment

FOR heating large industrial buildings, American Blower Company has added to its line of Venturafin Heating Units, described in the May 1924 issue of MANAGEMENT AND ADMINISTRATION, a new unit having about three times the capacity of the first unit.

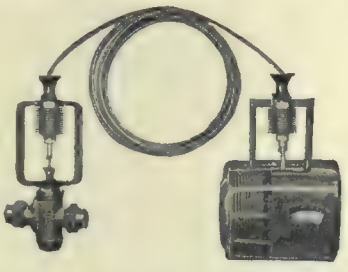
Design and operation of both units are the same. Steam is carried through a system of pipes, made of thin copper and wound with a helical brass "fin" to give greater heating surface, over which air is forced by a motor-driven fan.

With initial or room and final temperatures of 40 deg. and 111.3 deg. fahr. respectively, a unit delivers approximately 650,000 B.t.u. per hr. With temperature limits of 70 deg. and 128 deg., its capacity is about 500,000 B.t.u. per hr. The fan operates at 565 r. p. m. and delivers 8000 cu. ft. of air per min.

Automatic Temperature Control

FOR controlling temperatures in offices, factories, dryers, conditioning rooms, air ducts, and similar places, The Fulton Company has developed a self-contained control unit called the Regitherm. By the use of this unit it is possible to maintain any desired temperature regardless of variations in outside temperature or steam pressures. Offices, factory buildings, and processes can each be maintained at the temperature best suited to them, although served by the same steam system.

The device consists of a thermostat which is connected to the steam supply pipe by a flexible tubing having a syphon-bellows at each end. The tubing is filled with an incompressible liquid by means of which any movement of the thermostat is communicated direct to the steam valve. A single unit may be used to control temperature for each room or, where more precise control is desired, several Regitherms may be installed, each one connected to the steam supply serving that part of the room in which the thermostat is located.



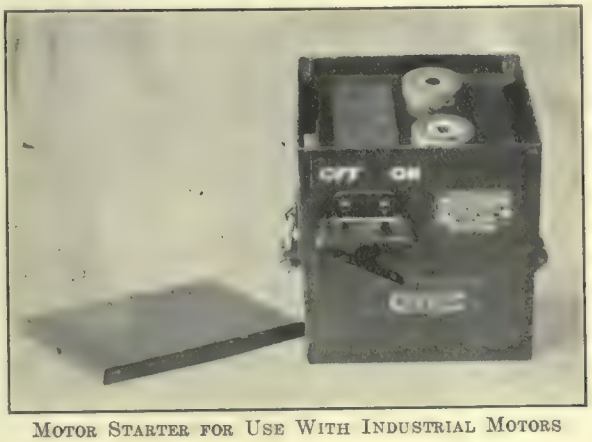
REGITHERM TEMPERATURE CONTROL UNIT

Standard range of temperature adjustment is from 60 to 80 deg. fahr., but for special uses any other range of 20 deg. can be furnished.

Motor Starter

A MOTOR starter designed for use with industrial motors of 5 hp. or less has been developed by Condit Electrical Manufacturing Company and is called Type N-4.

The entire starter is enclosed in a metal case which is small, compact and easy to install. Push button control or manual operation is available. Thermal cutouts provide overload time-lag protection for the motor. The operating coil is immersed in oil. A three-pole, single throw-switch is used as the starting element. The starter is for use with not more than 600 volts, nor more than 30 amperes.



MOTOR STARTER FOR USE WITH INDUSTRIAL MOTORS

Ball Bearing Chain Block

A SPUR geared chain block in which the full load is carried on ball bearings and which has been constructed with a large factor of safety to make its operation safe under unusual conditions has been developed by The Yale and Towne Manufacturing Company for use in hoisting or handling material in industrial plants.

Large-sized chrome-vanadium steel ball bearings carry the load as shown in the accompanying illustration, and their use decreases friction, lengthens the life of the block, and permits one man with a hand chain pull of 77 lb. to lift a 1-ton load. The top hook, crosshead, suspension plates, load sheave, electric-welded load chain, detachable shackle, bottom crosshead, and hook are all of steel.

BALL BEARING CHAIN BLOCK

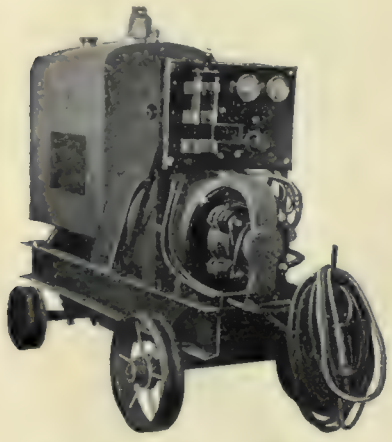
In a test during which the equipment was subjected to the force of one ton dropping through a distance of 25 in., the load chain, designed to stretch before breaking, elongated over 16 per cent, or nearly 6 in., without breaking.

but neither the ball bearings, gears nor other working parts of the block were adversely affected. These hoists are being marketed in capacities from ¼ to 20 tons.

Portable Arc Welder

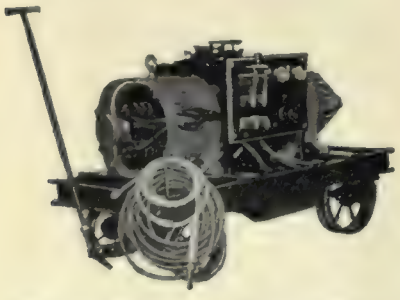
A COMPLETE, self-contained arc-welding unit, suitable for all industrial welding operations, that can be easily moved and used anywhere is being marketed by Wilson Welder and Metals Company, Inc.

The arc is easy to start and easy to maintain as a reactance automatically steadies it under all welding conditions. Current regulation is accomplished by



GAS ENGINE DRIVEN WELDER

turning knob of field rheostat. The generator is self-excited and is designed to give full load when welding with not more than 10 per cent current rise above that point on short circuit.



ELECTRIC DRIVE ARC WELDING UNIT

Either of two types of drive is available. One is by a standard 10 hp. electric motor with push button control. This drive is suitable for current range from 75 to 150 amperes and uses electrodes up to ¼ in. diam. The other drive is furnished by a 15-hp. Le Roi, 4-cylinder gasoline motor which gives a current range from 75 to 200 amperes and is suitable for electrons up to 5/16 in. diam.

Monorail Cable Conveyor

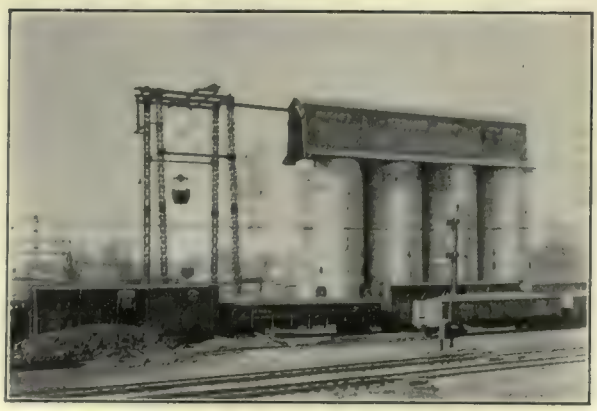
THIS equipment is designed for handling coal or similar materials and can be used in connection with cars, bins, silos, bunkers, or piles. It can be used either in the power-house or in the yard, and has a capacity of about one carload of coal per hour. It is being marketed by Conveyors Corporation of America.

The entire operation of the equipment is controlled by electricity. The complete motive unit is made up of two motor-driven drums, each operating independently of the other. All clutches have been eliminated. Magnetic brakes are used exclusively. When the bucket has been hoisted to its proper position, the hoisting motor is stopped and the brake set without attention from the operator. When the bucket approaches either end of the horizontal run, the motor is cut off automatically, effectually

INTERIOR OF CONTROL HOUSE SHOWING TWO MOTORS, BUCKET INDICATOR, AND ONE-MAN CONTROL

avoiding possibilities of damage to the equipment.

The bucket opens only on contact with the pile or ground, so that coal does not fall out with attendant degradation. An indicator shows the location of the bucket at all times. Sheaves and drums have large diameter to decrease cable wear. All gears are encased in cast-iron housings and run in oil. The oil bushed trolley is free-running and durable. A take-up device prevents sagging of the traction cable. The general design of the equipment is flexible, so that it can be adapted to practically any yard or operating conditions.



INSTALLATION OF MONORAIL CABLE CONVEYOR

Catalogs

Bulletin 142 issued by Wagner Electric Corporation contains information about their B B Type Split Phase Induction Motors.

A new 32-page bulletin has been issued by the General Electric Company describing four improved types of oil circuit breakers. The bulletin is illustrated, and details covering construction, operation, characteristics, etc., are fully covered. The circuit breaker types described are all for controlling and protecting circuits of large capacity.

A new information leaflet has just been published by The Griscom-Russell Co., describing the G-R Instantaneous Heater for supplying hot water for boiler feed, heating systems, industrial processes, etc.

A four-page bulletin, No. 141, has been issued by Wagner Electric Corporation describing their BA Type Repulsion-Induction Motors.

Ninety pages of Engineering Data Bulletins have been issued by The New Departure Manufacturing Company giving prices, applications, and technical information concerning the use of ball bearings on automotive equipment.

Bulletins 118 and 118-A, issued by Uehling Instrument Company, describe the Apex Pneumatic CO_2 Meter and the Apex CO_2 Recorder.

A four-page bulletin has been issued by the Brown Instrument Company emphasizing the advantages of using heat measuring instruments.

Specifications and prices of their extensive line of gears is contained in Catalog No. 29 issued by W. A. Jones Foundry and Machine Company. It contains diagrams, other illustrations, and considerable data on gears.

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 100 magazines; it also includes the publications of some 50 book publishers and professional societies as far as these are of managerial interest to industrial executives. The decimal number at the right of each item is the index number and indicates the place the article or book will take when filed in accordance therewith in the classified subject scheme. If articles are grouped according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. Photostat copies of any magazine article indexed will be supplied by The Ronald Press Company within a year following the date of publication at a price of 25 cents the page. When ordering photostats please identify the article by quoting from the index: (1) Title of article; (2) Index number; (3) Name, date, volume number, and page number of periodical in which the item appears. A remittance of 25 cents a page should accompany the order. The books and pamphlets indexed can be procured from The Ronald Press Company or from their respective publishers.

Industrial Buildings and Plant Maintenance

Buildings and Equipment

Air Conditioning for the Manufacture and Storage of Candy. 658.25
Eilert Nesdahl. *Candy Factory,* February 1925, v. 5, pp. 21-22. Description of successful installation.

Choosing the Factory Floor. 658.22
B. R. Magee and H. K. Ferguson. *Industrial Management,* January 1925, v. 69, pp. 28-32. Materials, methods of construction, and adaptability to conditions of use.

Factory Lighting Progress. 658.24
(We Could Pay the War Debt in One Year.) M. Luckiesh. *Factory,* January 1925, v. 35, p. 28. An estimate that increased production, lessened accident and reduced labor turnover and spoilage which might be brought about by up-to-date lighting in factories would pay the entire war debt of the United States in a single year.

Good Industrial Lighting: Its Value to the Consumer. 658.242
J. S. Dow. *Business Organization and Management,* January 1925, pp. 249-252. One per cent of pay-roll spent in improving factory illumination offers great possibilities of decreased number of accidents, better health of workers, and increased production.

Industrial Buildings. 658.23
(Tendencies in Building Design.) *Factory,* January 1925, v. 35, pp. 49-52, 210.

Industrial Partitions in Office and Factory. 658.23
F. E. Gooding. *Industrial Engineer,* January 1925, v. 83, pp. 23-26, 46. Illus. Steel enclosures for departments, shop offices, etc.; factors of layout.

The Paradox of Electric Heating. 658.25:621.3
C. L. Wilson. *Industrial Management,* January 1925, v. 69, pp. 45-48. Convenience, close heat control, and automatic regulation make electricity the most economical heat source in some cases.

Proper Foundry Illumination. 658.24
W. H. Rademacher. *The Foundry,* January 1925, v. 53, pp. 29-33. Illus. Analysis of difference between hit-or-miss methods and scientific use of artificial illumination with practical illustrations showing benefits derived from efficient lighting.

Maintenance and Repair

First Aid When the Blaze Starts. 658.284
E. J. Smith. *National Safety News,* February 1925, v. 2, pp. 31-32. Maintenance and operation of fire preventing and fighting appliances.

Maintenance Practice at the Ford Plant. 658.58
E. E. Remington. *Journal of the Society of Automotive Engineers,* January 1925, v. 16, pp. 82-85. Illus. Organization, equipment, and operation of the maintenance department of the Highland Park plant, covering all fields except electrical work and machine repairs.

Plant Maintenance. 658.58
K. D. Hamilton. *Factory,* January 1925, v. 35, pp. 56-60, 194.

What Maintenance Includes and How It Is Handled. 658.58
C. D. Corwin. *Industrial Engineer,* February 1925, v. 83, pp. 50-51, 110. Illus. Details of work done and organization required by the Corona Typewriter Co.

Power Generation and Transmission

Fuel

Burning Gas. 658.261
(How to Increase Your Day Load.) *The Gas World,* January 24, 1925, v. 82, pp. 65-66. Suggestions and data relating to the advisability of burning gas under industrial boilers.

The Fallacy of Oil as Industrial Fuel. 662.6
William Sibley. *Steam Coal Buyer,* January 1925, v. 3, pp. 11-12. Relative scarcity of oil reserves compared with those of coal make use of oil as industrial fuel hazardous undertaking. More economical use of coal is solution to fuel problem.

The Fuel Situation. 662.6
(A Review of the Tendencies in the Use of Fuel in Industry.) *Factory,* January 1925, v. 35, p. 40.

Industry Finds New Uses for Gas. 662.76
K. D. Cassidy. *Michigan Manufacturer and Financial Record,* January 24, 1925, v. 35, pp. 1-2. Illus. Applications to manufacturing processes in various plants.

Influence of Ash in Coal. 662.6
H. A. Woodworth. *Steam Coal Buyer,* January 1925, v. 3, pp. 26-28. Charts. Relative efficiency and economy between high ash and low ash coals for industrial use.

Power Equipment

Buying and Operating Electrical Equipment. 621.3
F. Johnstone-Taylor. *Canadian Machinery,* January 29, 1925, v. 33, pp. 25-26. Diag. Factors to be considered in purchasing new equipment with formulas and table for determining their value.

The Diesel Engine in Small and Medium-Sized Power Plants. 658.261:621.4
Ray C. Burns. *Universal Engineer,* January 1925, v. 41, pp. 32-33. Possibilities of more economical power production in comparison with small steam plants.

Maintaining Furnaces in the Paper Mill. 658.58
H. C. Evans. *Paper Trade Journal,* January 15, 1925, v. 80, pp. 47-50. Experience data on repair and replacement of refractory materials in power plants.

Present-Day Heavy-Oil Engines. 621.4
J. L. Chaloner. *World Power,* January 1925, v. 3, p. 31. Illus. Description of low, medium, and high pressure oil engines made in England, as an aid to selection of equipment.

The Ruths Steam Accumulator and Its Applications. 621.18
Alfred J. T. Taylor. *Paper Trade Journal*, January 29, 1925, v. 53, pp. 49-58. Illus. Charts. Applications and advantages of steam accumulator for compensating variations in steam demand for power and process.

Steam Piping Requirements for Fuel Economy in Small Plants. 621.18
Steam Power, January 1925, v. 3, pp. 7, 12, 14. Report of studies made by Engineering Experiment Station of the University of Illinois.

Power Plant Operation

Automatic Control of Combustion. 658.26
T. A. Peebles. *Mechanical World*, January 9, 1925, v. 77, p. 26. Reduced fuel costs and improved operation can be obtained by automatically controlling combustion under boilers.

Heat Salvage Progress in 1924. 658.261
W. C. Buell, Jr. *Fuels and Furnaces*, January 1925, v. 3, pp. 45-46. Adequate equipment plus good operating practice produce the greatest amount of heat from the smallest amount of fuel.

Reducing Excessive Boiler Fuel in Small Gas Plants. 658.261
C. L. C. Kah. *Gas Age Record*, January 10, 1925, v. 55, pp. 39-40. Methods of determining boiler and furnace efficiencies and a few suggestions for increasing them.

The Stoker's Part in the Power Plant World of Today. 621.18
Russell T. Gray. *Steam Power*, January 1925, v. 3, pp. 5, 10. Benefits of stokers over hand-firing.

A Super-Power Plant. 621.101
F. J. Crolins. *The Blast Furnace and Steel Plant*, January 1925, v. 13, pp. 55-59. Design and operation of new steam power plant of Ford Motor Company at Walkerville, Ontario.

Power Transmission

Can We Standardize Power Plant Lubrication? 621.89
A. F. Brewer. *Industrial Management*, January 1925, v. 69, pp. 19-23. Illus. Explanation of specification, terms and characteristics of oils and compounds.

Do Ball and Roller Bearings Justify Their Cost? 658.262
H. Maxwell. *Industrial Engineer*, January 1925, v. 83, pp. 12-18. Illus. Comparison of ball, roller and sleeve bearings and their economies, for general-purpose motors.

The Dollar Value of Wasted Kilowatts. 658.262
E. S. Lincoln. *Industrial Management*, January 1925, v. 69, pp. 7-10. Leaks in the electrical system and how to prevent them.

Industrial Power. 621.31
(Advance of the Super-Power Movement.) *Factory*, January 1925, v. 35, pp. 45-46. The progress made in production and application of industrial power during 1924.

Marketing and Distribution

Advertising

Blazes Trail to Jobbing Profits. 658.82
Dan M. Devy. *The Foundry*, January 1, 1925, v. 53, pp. 3-7. Illus. Efficient service to customers coupled with proper advertising overcomes competition and makes operation profitable.

Can a Manufacturer Ever Afford to Stop Advertising? 659.1
Anonymous. *Printers' Ink*, January 15, 1925, v. 130, pp. 3-4, 6, 172, 175, 176, 178, 181, 182, 184. The author answers "no" and proves his point by illustrations from the experience of many well-known companies.

Copy That Sold American Goods in King George's Land. 659.1:382
Cameron McPherson. *Sales Management*, January 10, 1925, v. 8, pp. 79-81, 118. Illus.

Effective Dealer Helps for Retailers Abroad. 659.1:382
Printers' Ink, January 15, 1925, v. 130, pp. 129, 130, 132, 137, 138. Suggestions and advice to advertisers for preparing copy that will be effective in foreign markets.

How to Help Your Retailer Show the Product. 659.133
A. H. Van Voris. *Printers' Ink*, January 8, 1925, v. 130, pp. 17-20. Successful methods used by five manufacturers.

More Clarity, Please, in Your Package Directions. 658.7884
Ruth Leigh. *Printers' Ink*, January 29, 1925, v. 130, pp. 93-94, 96-97. Directions on consumer packages should be understandable by the most stupid user, accurate, and legible.

Why and How Brunswick Changed Its Advertising Policy. 659.1
P. L. Deutsch. *Printers' Ink*, January 15, 1925, v. 130, pp. 41, 42, 44, 48, 53. Advertising must be sensitive to markets and flexible so that greatest expenditures are made where possible returns are most encouraging.

Selling

Are Salesmen Selling Too Many Things Besides Merchandise? 658.8
Frank R. Jones. *Printers' Ink*, January 29, 1925, v. 130, pp. 3, 4, 6, 168. Selling service and his house aid in making resales, but the primary purpose of salesman is to sell merchandise.

Begging Sales Opportunities in the Electric Railway Field. 658.82
C. W. Hamilton. *Sales Management*, January 10, 1925, v. 8, pp. 23, 24, 66, 68. Illus. Successful methods used in developing new sales possibilities.

Budget Sales Quota: a Problem and Suggested Solution. 658.14:658.8
Joseph H. Barber. *Harvard Business Review*, January 1925, v. 3, pp. 210-220.

Changes in Trade and Exchange With Central America. 382
W. F. Spaulding. *Business Organization and Management*, January 1925, v. 11, pp. 261-264. A resumé, for British consumption, of Central American trade conditions. It shows that the United States has increased its influence in that market.

Constructive Merchandising. 658.8
Robert E. Ramsay. D. Appleton and Company, New York. 718 pp. $6. Illus. A very complete manual of merchandizing plans and practices. It has been built almost entirely on experience. All the problems that may confront every type of distributor are discussed and, with very few exceptions, the author has been able to find some concern that successfully solved each particular problem and was willing to outline their methods in such a way that others in widely different fields might benefit by their experience. Because of this very strong flavor of successful experience backing up the author's statements, the book is thoroughly practical. Illustrations are used profusely to clarify and amplify verbal statements concerning methods or mechanisms. Not the least valuable part of the book is an exceptionally comprehensive index. To distributors of every type this book should be a valuable text and reference book on merchandizing.

Distribution, Not Production, Is Problem of Today. 658.8
E. L. Shaner. *Iron Trade Review*, February 5, 1925, v. 76, pp. 379-383. Illus. Examples of business failures where the advantages of superior design and efficient production were lost through ineffective distribution methods.

How Shall We Establish the Sales Quota? 658.8
Ralph Crothers. *Printers' Ink Monthly*, February 1925, v. 10, pp. 25-26, 63.

How to Compensate Salesmen in the Industrial Field. 658.8:658.32
N. C. Tompkins. *Printers' Ink*, January 1, 1925, v. 130, pp. 140, 143, 144, 146, 149, 150, 152. Experience data and plans of several manufacturing companies.

Keeping the Salesman (Traveller) in the Dark. 657.85
Bruce Barton. *Sales Management* (London), December 15, 1924, v. 4, pp. 609-610. Value of keeping traveling men posted on new developments and happenings at the home office.

The Neglected Branch Manager and Sales Control. 658.85
Richard Warren. *Printers' Ink Monthly*, February 1925, v. 10, pp. 41-42. Suggestions aiding him in his selling work.

This Plan Harvests Two Sales Where One Grew Before. 658.82
Walter P. Hanson. *Printers' Ink*, January 22, 1925, v. 130, pp. 121, 122, 124. It insures complete information about each purchase reaching the manufacturer for use in a well-planned follow-up campaign.

Planning Salesmen's Work to Save Their Time. 658.85
C. K. Woodbridge. *Printers' Ink Monthly*, February 1925, v. 10, pp. 17, 18, 125-127. Methods used by Dictaphone Sales Corporation in budgeting salesmen's efforts.

Preparing the Salesman's (Traveller's) Way. 658.82
Eric N. Simons. *Sales Management* (London), December 15, 1924, v. 4, pp. 616, 618, 620. Direct mail advertising prior to salesman's call is great help in securing new business.

Profit-Making Possibilities in Solving Marketing Problems. 658.82
B. A. Franklin. MANAGEMENT AND ADMINISTRATION, March 1925, v. 9, pp. 245-248. Discussion of the more essential requirements of successful marketing.

The Salesman Who Gets Unsold on His Company's Line. 658.80
V. V. Lawless. *Advertising and Selling Fortnightly*, January 14, 1925, v. 4, pp. 19, 58-59. Some methods for reselling him on the product he is carrying.

When the Sales Campaign Goes Wrong. 658.85
(Feeling the Public Pulse.) Harold Herd. *Business Organization and Management*, January 1925, v. 11, pp. 279-282. Methods of analyzing reasons for failure for use not only in preventing subsequent misfires but to turn the present one into a successful campaign.

Why Not Abolish the Credit Department? 658.88
Anonymous. *Printers' Ink*, January 1, 1925, v. 130, pp. 3-4, 6, 161, 162. Conservative credit policies are increasing selling costs. Looser credit policy would lead to greater sales obtained at less expense.

Yankee Goods; the British Barrage. 380.012
Winthrop C. Hoyt. *American Industries*, January 1925, v. 25, pp. 5-7. Influence of internal conditions in England on the British market for American products.

Shipping

Air Cleaners on Trucks in Service. 656.124
A. H. Hoffman. *Journal of the Society of Automotive Engineers*, February 1925, v. 16, pp. 249-256. Illus. Investigation of the effectiveness of air cleaners in eliminating wear and maintaining efficiency of operation.

Commercialized Motor Truck Haulage. 656.124
J. A. Hoffman and W. F. Banks. *Journal of the Society of Automotive Engineers*, January 1925, v. 16, pp. 62-72. Organization, operation, maintenance, and cost accounting in connection with the running of a motor truck fleet.

Conference Acts to Improve Distribution Methods. 381
Iron Trade Review, January 29, 1925, v. 76, p. 354. Program mapped out at the national conference held January 14 and 15 in Washington by the U. S. Chamber of Commerce.

Getting Rid of the Export Crate. 658.788:382
G. F. Bauer. MANAGEMENT AND ADMINISTRATION, March 1925, v. 9, pp. 241-244. Illus. Immediate prospects of selling 6,000 more automobiles a year abroad by saving the cost of the shipping container.

How Portland Cement Is Distributed. 650:666.94
Morris Kind. Hercules Cement Corporation pamphlet, 21 pp. Description of methods used to lower costs of distributing cement from producer to consumer.

Motor Transport of Goods. 656.124
James A. Dunnage. *Cassier's Industrial Management*, January 1925, v. 12, pp. 105-110. Illus. Selection of vehicle; advantages and operating costs of each type; control of fleet.

Must Carriers Weigh Materials? 656.23
N. D. Belnap. *Cement, Mill and Quarry*, January 5, 1925, v. 26, pp. 13-15. Manufacturer's viewpoint on determinations of weights of freight by carriers, with legal cases.

Packing and Dispatching of Goods. 658.788
George B. Lissenden. *Cassier's Industrial Management*, January 1925, v. 12, pp. 100-104. Illus. Suggestions for reducing shipping costs, loss, and damage claims.

Packing Protection from the Jobber's Angle. 658.7884
Raymond Watts. *Packages*, January 1925, v. 28, p. 16. Wood boxes are stronger than paper-fiber containers and their use for packing easily damaged goods prevents claims and pleases jobbers.

Simple Methods of Reducing Damage to Shipments. 658.788
W. H. Upson, Jr. MANAGEMENT AND ADMINISTRATION, March 1925, v. 9, pp. 233-234. From the experience of The Upson Company.

General Management and Policy

Administration and Policy

Fancy Profits, Small Profits, No Profits, Go to Make Average Profits. 338.5
G. A. Nichols. *Printers' Ink*, January 22, 1925, v. 130, pp. 3-4, 6, 8, 169, 170, 172, 175. What purchasers will pay, and not cost of the goods determines selling prices that move goods. Some truths about pricing practice.

The Ford Engineering Laboratory. 658.2
G. E. Hagemann. MANAGEMENT AND ADMINISTRATION, March 1925, v. 9, pp. 219-222. Illus. Great institution at Dearborn in which center all the vast experimental and research activities of the Ford Motor Company.

German Trade Associations. 338.6
Archibald H. Stockder. Henry Holt and Company, New York. 254 pp. $4. Manufacturers interested in the development of trade associations in this country will find much information in this description of the influence of trade associations, or *kartells*, in Germany. The particular *kartell* discussed is that of the coal industry, but its organization, methods, and influence upon its members and the economic life of the country are typical of other associations. Developments in Germany where trade associations have not only been encouraged but, in some instances, originated by the government furnish innumerable suggestions for similar development in this country.

Growth of Well-Known Industrial Centers. 658.2:33
F. E. Gooding. *Industrial Engineer*, January 1925, v. 83, pp. 6-11, 46. Illus. Available sources of power, and other controlling factors which have determined plant location.

Saturation Point for Motor Cars Pushed Ahead to 27,000,000. 656.124
L. P. Ayres. *Journal of the Society of Automotive Engineers*, February 1925, v. 16, pp. 195-196, 208. Problem before the industry lies in avoiding overproduction.

The South—A New Industrial Frontier. 658.11
J. A. Piquet. *Industrial Management*, January 1925, v. 69, pp. 11-18. Illus. Factors in the industrial development of the southern states.

Taking Up the Post-War Slack. 658.5
H. R. Simonds. *Iron Trade Review*, January 22, 1925, v. 76, pp. 277-280. Illus. How the Colt's Patent Fire Arms Mfg. Co. adapted their plant to peace-time products.

Trade-Marks Prove Effective Pulling Repeat Orders. 608
Frank G. Stinebach. *The Foundry*, February 1, 1925, v. 53, pp. 93-96. Illus. Requirements for effective trade-marks and how they may be used to increase sales of any product.

What Industrial Psychology Asks of Management. 150:658
W. V. Bingham. *Bulletin of the Taylor Society*, December 1924, v. 9, pp. 243-248. Psychologists and management engineers are drawing together. Industrial psychol-

ogists in this relationship ask of management 4 things: patience, discrimination, research opportunities and reliable criteria.

Why Quality Tools Are Invariably the Cheapest. 658.27
A. Brown. *Canadian Machinery*, January 29, 1925, v. 33, pp. 21-22. Contains formulas for comparing economy of purchasing high-grade or low-grade machines.

The Yearly Model Problem Fades. 658.575
Michigan Manufacturer and Financial Record, January 17, 1925, v. 35, pp. 22-23. Motor makers reveal trend toward economy by adding improvements rather than styles.

Economics

The Basis of Industrial Psychology. 150:658
Elton Mayo. *Bulletin of the Taylor Society*, December 1924, v. 9, pp. 249-259. The basis for industrial psychology is the scientific work done both in academic and medical psychology. The approach to the factory is through existing problems restated in terms of the situation as it concerns individuals and the factory itself.

The Business Life—Economics for Business Men. 33
Hugh W. Sanford, Oxford University Press, American Branch, New York. 2 vol. 959 pp. $10. The author, a practical manufacturer, has worked out in his own mind a clear picture of the relation of political economy to human existence and presents it in a way that will appeal to other practical business men. He finds that "the business of life" is based on economics, philosophy, and biological knowledge, and proceeds to explain how he arrived at this conclusion, and how it affects the business of living. The work is written for business men and in language that will help to clarify many hazy ideas concerning broad aspects of political economy. The first part is "devoted to political economy, finance, business fluctuations and the laws of production and distribution under a competitive regime." Following this is an attempt at a philosophical explanation of economics, involving fundamental questions of biological evolution. The last part describes proper conduct for the ideal state.

Classification of Engineering and Industrial Standards. 658.516
F. J. Schlink. *Mechanical Engineering*, February 1925, v. 47, pp. 119-122.

The Future of Wages and Labor Costs. 331.2153
Leo Wolman. *Proceedings of the Academy of Political Science*, January 1925, v. 11, pp. 145-151. High levels of industrial activity, increasing business profits and rising prices are predicted with attendant increase of wages. Because of improving production methods and absence of definite information regarding their past relationship, increased wages do not mean, necessarily, higher labor costs.

Man and His Affairs. 33
Walter N. Polakov. Williams and Wilkins Co., Baltimore, 227 pp. $2.50. Most books presented to engineer or business man have the appeal of fact, of immediate use. It is refreshing to find in this volume something quite different although it is written from an engineering point of view. It appeals because it makes the reader think. The aim, as the author puts it in one place, is "to stimulate in the reader not so much the interest in the subjects touched upon but the desire to do some rigorous thinking." Scorn is poured over much that passes current for fact, reasoning and principle, but the attack is not solely destructive—a way out is indicated. "Battlefields must be shifted into day nurseries and kindergartens; not the gas mask but mathematical, natural logic will protect people from poisoned atmosphere; not anti-typhus serum but germs of scientific thought will prevent the spread of deadly notions of metaphysical nonentities. Scissors and erasers should take the place of bayonets and tanks, removing from school books the last vestige of mental fictions and fallacious doctrines." And again, "what is needed is to elevate the general education of the masses to the extent that the man in the street can appreciate the scientific *mode of thinking*, that is, its logic, method and aim." Amid industrial disputes and controversies, the picture is drawn of a time when the parties concerned will sit down and calculate a settlement. The book will repay the time and effort required for its reading, although some will object to the discarding of spiritual forces from any consideration of "man and his affairs."

Manufacturing Operations and the Business Cycle. 338.97
William L. Crum and Homer B. Vanderblue. *Harvard Business Review*, January 1925, v. 3, pp. 171-184. Study of statistics of two manufacturing enterprises to show the relations between the business cycle and manufacturing operations and also to suggest how such analysis may be made without subjecting the data to lengthy computations.

The Movement of Wages and the Future of Prices. 331.2
Paul H. Douglas. *Proceedings of the Academy of Political Science*, January 1925, v. 11, pp. 90-98. Economic discussion of relation between wages and prices which tends to prove that fluctuating wages have little effect on prices.

Price Making and Price Stability. 338.5
A. M. Sakolski. *Harvard Business Review*, January 1925, v. 3, pp. 204-209. Price stability is essential to general economic and industrial progress. Discussion of means for securing it.

Profitable Science in Industry. 6:658
Dwight T. Farnham, H. E. Howe, R. W. King, and J. A. Hall. The Macmillan Company, New York. 290 pp. $3.50. Discussion of the applications and value of science in industry. The four general subjects treated are: The general principles of scientific management in industry; the value of chemical knowledge and the service of the chemist in manufacturing plants; what the development of electrical knowledge means to industry; and the contributions made by mechanical engineers toward more profitable industrial operation. Not only is this book interesting but it contains much information of value to industrial managers which may suggest worth-while improvements in their present practices.

The Relations Between Industrial Management and Price Levels. 338.5
Magnus W. Alexander. *Proceedings of the Academy of Political Science*, January 1925, v. 11, pp. 122-144. Management using scientific intelligence and farsighted leadership can increase the social surplus, make wages more effective, and prices more stable and sound.

Social Consequences of Business Cycles. 338.97
Maurice B. Hexter. Houghton Mifflin Company, New York. 206 pp. $4. A study undertaken under the auspices of Pollak Foundation for Economic Research. Using the statistical processes which the Harvard Committee on Economic Research applies to business statistics, the author proves that social phenomena such as births, deaths, marriages, divorces, etc., possess a certain cyclical character which has a definite relation to business fluctuations.

The Truth About Germany's Industrial Revival. 382
Sir Philip Dawson. *Industrial Management*, January 1925, v. 69, pp. 1-6. Methods by which German industrial firms developed foreign markets.

Would Check Waste by Preventing Booms. 338.97
Iron Age, January 22, 1925, v. 115, pp. 287-288. Interview with Secretary Hoover and Richard F. Grant on the possibility of preventing waste in business and industry by the prevention of business booms.

Management

Abrasive Development Is in Formative Stage. 658.5
Fred B. Jacobs. *Abrasive Industry*, February 1925, v. 6, pp. 30, 31, 40. Analysis of present progress in grinding methods and possibilities for future applications in industrial processes.

Beech-Nut Purchasing System Controls All Material and Supplies. 658.7
John Gore. MANAGEMENT AND ADMINISTRATION, March 1925, v. 9, pp. 235-240. Illus. Detail description and operation.

The Careful Worker Has the Call. 658.567
S. Seiders. *Michigan Manufacturer and Financial Record*, January 10, 1925, v. 35, pp. 7, 23. Elimination of waste by cooperation of workers, with examples.

Changes in Mechanical and Electrical Equipment. 657.2
Industrial Engineer, February 1925, v. 83, pp. 52-54, 113. Illus. Representative cases from typical plants, and reasons for adoption of new methods and apparatus.

The Economic Aspect of Tooling for Interchangeable Production. 621.9
J. Lannen. *Journal of the Society of*

Automotive Engineers, January 1925, v. 16, pp. 59-61. Methods of selecting correct types of equipment and producing low-cost tools at the Paige-Detroit Motor Car Co. Discussion of this paper appears in the Journal, February 1925 issue, pp. 225-226, 242.

Elimination of Waste—Simplified Practice. 658.516
United States Department of Commerce. Pamphlet, 32 pp. Review of what simplified practice is; what it has already accomplished; and the opportunities it offers for the future.

Gas Welded Structures and Cutting Torch. 658.581
D. C. McGeihan. *Cement, Mill and Quarry*, February 5, 1925, v. 26, pp. 16-17. Illus. Applications to repair jobs on material-handling machinery.

Give Buffing and Polishing Data. 658.7
Frederick B. Stevens. *Abrasive Industry*, January 1925, v. 6, pp. 12-14. Careful study of materials used for grinding operations results in better looking, more easily salable products.

Graphic Analysis for Executives. 658.53
Winfield A. Savage. Codex Book Company, New York. 141 pp. $4. Presents facts for the application of graphic analysis methods to business management problems. It tells what kinds of charts to use for the specific purposes of managerial control and analysis of figures. A large number of charts are used, some of them colored. The book is concise and should be a valuable handbook for executives in search of definite ways for graphically presenting facts about their business.

How Dennison Handles Broad Problems of Management. 658.315
Roy W. Johnson. *Sales Management*, January 24, 1925, v. 8, pp. 137-138, 198, 202. Industrial partnership plan puts control of policies squarely up to the executive employees who share in profits and in responsibility for loss.

Management in Pioneer Days. 658(09)
E. W. Rice, Jr. MANAGEMENT AND ADMINISTRATION, March 1925, v. 9, pp. 217-218. Development of functionalization, cost estimating, expense distribution, and service to customers during the period from 1884 to 1890 at Lynn plant of Thomson-Houston Company.

Management's Progress in 1924. 658.5
(Management Progress Toward New Standards.) *Factory*, January 1925, v. 35, pp. 21-26. Reviews of leaders in industry emphasizing progress through closer executive control, reduction of costs, production control, elimination of waste and increase of manufacturing turnover.

Our Statistical Charts. 311
Stanley Bryon. *Paper Trade Journal*, January 29, 1925, v. 53, pp. 59-62. Charts. Description of design and uses of charts used by the Hammermill Paper Company.

Planning the Output of a Semi-Standard Product. 658.5:621.3
Engineering Production, January 1925, v. 8, pp. 26-27. British practice applied to electric motor production.

The Principles and Practice of Time Study. 658.5421
H. W. Dickson. *Industrial Management*, January 1925, v. 69, pp. 39-44. Outline of elementary operations in handling time-study investigations.

Processing and Rate Fixing. 658.5
W. Symes. *The Cost Accountant*, December 1924, v. 4, pp. 223-231. Organization and operation of department for improving manufacturing efficiency by bettering product design, production methods, and wage payments.

Shop Equipment Review. 621
American Machinist, January 15, 1925, v. 62, pp. 81-143. Illus. A semi-annual resumé of machine tools and accessories used principally in machine shops and previously described in the weekly section, "Shop Equipment News" of the *American Machinist* during the period July to December, 1924.

Simplification. 658.516
(Achievement and Promise.) *Factory*, January 1925, v. 35, pp. 26-27. Record of what simplification and standardization have achieved for industry up to date.

Some Steel Problems in the Drop Forging Industry. 658.5:669.1
M. H. Schmid. *Forging—Stamping—Heat Treating*, January 1925, v. 11, pp. 2-7. Co-operation with steel producers necessary to meet demands of consumer. Inspection, and avoiding production defects.

Standards for Screwed Fittings. 658.516
(Proposed American Standards for Malleable and Cast Iron Screwed Fittings.) Collins P. Bliss. *Mechanical Engineering*, February 1925, v. 47, pp. 117-118. Covers standard dimensions for three complete series of fittings: (1) Malleable iron screwed fittings designed for 150 lb. working steam pressure; (2) cast-iron screwed fittings designed for 125 lb. steam pressure; (3) cast-iron screwed fittings designed for 250 lb. working steam pressure.

Use of Preferred Numbers. 658.516
F. J. Schlink. *Journal of the Society of Automotive Engineers*, February 1925, v. 16, pp. 140-143. Illus. Purpose and derivation of preferred-number series explained.

Utilization and Prevention of Waste. 658.567
C. B. Auel. *Journal of the Society of Automotive Engineers*, February 1925, v. 16, pp. 223-225. Discussion of a paper presented before the S. A. E. and appearing in the November 1924, issue of the Journal.

Waste Elimination. 658.567
(Are We Gaining Ground in Waste Elimination?) *Factory*, January 1925, v. 35, pp. 47-48. Evaluation of progress made in elimination of factory industrial wastes since 1921.

What the Workers' Waste Means. 658.567
Seth Seiders. *American Industries*, January 1925, v. 25, pp. 22-23. American business throws away billions of dollars annually through its ignorance of the cost of carelessness, wastefulness, and similar obstacles to most economical production.

Material Handling and Production Control

Material Control

Heat Treating Machine Parts. 658.512
E. F. Ross. *Iron Trade Review*, January 29, 1925, v. 76, pp. 341-343. Illus. Carefully devised system of routing material enables small hardening department to handle work for R. K. LeBlond Machine Tool Co.

Salvaging Inspection Rejects. 658.57
P. H. Bryant. *Machinery*, February 1925, v. 31, pp. 428-429. Work standards and inspection methods can be co-ordinated to reduce waste.

When Buying Castings. 658.7
W. J. Corbett. *Iron Trade Review*, January 22, 1925, v. 76, pp. 282-284. How design affects product; making of patterns; calculating costs; relations of buyer and seller.

Mechanical Handling

Aerial Rope Transport. 658.281
T. E. Dodds. *Cassier's Industrial Management*, January 1925, v. 12, pp. 58-66. Illus. Economical both in installation and operating costs, applications of aerial ropeways are given and their advantages described.

Coal and Ash Handling in the Power House. 658.281
W. D. Wylde. *Cassier's Industrial Management*, January 1925, v. 12, pp. 30-37. Illus. Review of latest systems with description of their applications and advantages in power house operation.

Cranes. 621.87
Claude Martineau Toplis. *Cassier's Industrial Management*, January 1925, v. 12, pp. 38-43. Illus. Description of types of cranes used in industry with suggestions for design and operation for particular services.

Economical Handling of Material. 658.281
E. Tonkin. *Forging — Stamping — Heat Treating*, January 1925, v. 11, pp. 24-26. Illus. Methods employing tractors, trailers, racks and tote boxes in a drop forge shop.

The Electric Telepher. 658.281
Herbert Blyth. *Cassier's Industrial Management*, January 1925, v. 12, pp. 79-85. Illus. Applications and advantages.

Electro Magnets. 658.281
J. B. Kramer. *Cassier's Industrial Management*, January 1925, v. 12, pp. 74-78.

Illus. Applications of lifting magnets for handling scrap, etc., in industrial plants.

Engineering of Material Handling Machinery Installations. 658.281
E. T. Bennington. *American Machinist*, January 29, 1925, v. 62, pp. 195-197. Descriptive article emphasizing that material-handling principles are applicable in all industries and that handling machinery must keep pace with production machines.

Fundamental Economics of Materials Handling. 658.281
M. L. Begeman. *Cassier's Industrial Management*, January 1925, v. 12, pp. 13-19. Illus. Discusses the necessity for installing mechanical handling equipment and the savings in production costs resulting from it.

The Importance of Feeders for Conveyors. 658.281
M. W. Potts. *Industrial Management*, January 1925, v. 69, pp. 56-62. Illus. Description of various types of material-feeding mechanisms.

Lumber Handling Simplified. 658.281
T. D. Perry. MANAGEMENT AND ADMINISTRATION, v. 9, pp. 229-232. Illus. Modern storing methods, and 3 types of equipment which have lowered the costs of handling.

Material Handling. 658.281
(Material Handling's Larger Part in Production.) George F. Johnson. *Factory*, January 1925, v. 35, pp. 41-43, 212. Practice of the Endicott Johnson Corporation in the wholesale adoption of machine methods of moving materials.

Mechanical Handling at Rail and Water Terminals. 658.281
George Bulkely. *Cassier's Industrial Management*, January 1925, v. 12, pp. 92-99. Illus. Problems confronting industrial executives in material transfers at terminals and methods and equipment for solving them.

Mechanical Handling in the Factory. 658.281
George Frederick Zimmer. *Cassier's Industrial Management*, January 1925, v. 12, pp. 20-29. Illus. Summary of the applications of conveying equipment in the factory, its advantages over hand labor, and cost reductions made possible by its use.

Notes on Elevators. 621.86
Newman Tate. *Mechanical World*, January 23, 1925, v. 77, pp. 54-55. Applications, advantages, and operating data for various types of elevator equipment.

Recent Developments in Pneumatic Conveying. 621.86
E. G. Phillips. *Cassier's Industrial Management*, January 1925, v. 12, pp. 67-73. Illus.

Standardization of Product Aids Handling. 658.281
E. T. Bennington. *The Iron Age*, January 29, 1925, v. 115, pp. 344-346. Illus. Uniform containers advocated as further step toward lower material-handling costs. Wire mill practice.

The Storage Battery Locomotive. 656.2
J. G. Byrnes. *Coal Mine Management*, January 1925, v. 4, pp. 52, 54, 55, 58, 60. Illus. Comparison with other types and explanation of its advantages, especially in mine service.

Underground Belt Transportation of Coal. 658.281
T. W. Dawson. *Coal Mine Management*, January 1925, v. 4, pp. 23-31, 36-42, 51. Illus. Extensive system installed by the H. C. Frick Coke Co. to handle 8500 tons per day. Comparison is made of estimated power data and actual measured values after installation.

Production Control

Baking Enamel by Electricity. 658.5:689
H. Allen. *Iron Trade Review*, January 15, 1925, v. 76, pp. 220-222. Large-scale production methods which maintain quality, economy and dependability.

Cutting Cast Iron and Copper Alloys by the Electric Arc Process. 658.561
A. G. Bissell. *Machinery*, February 1925, v. 31, pp. 445-446. Illus.

Enter Order — When Will You Ship? 658.5
H. S. Riggs. MANAGEMENT AND ADMINISTRATION, March 1925, v. 9, pp. 253-257. Illus. Detail operation of production control system used by Lodge and Shipley Machine Tool Company.

Maintaining Train Control Equipment on Locomotives. 658.56
E. Wanamaker. *Railway Mechanical Engineer*, January 1925, v. 99, pp. 40-44. Illus. Methods and inspection system in the Chicago, Rock Island & Pacific shops.

Operating and Managing Motor Repair Shops. 658.5:689
G. P. Svendson. *Industrial Engineer*, January 1925, v. 83, pp. 27-29. Illus. Handling a fluctuating volume of work; cost accounting; stores control.

Planning and Production Control. 658.51
Bulletin of the Taylor Society, December 1924, v. 9, pp. 271-283. Gives a composite picture of the planning methods found effective in Boston's most efficient factories. Prepared by the Committee on Industrial Planning of the Boston Chamber of Commerce.

Production Control. 658.51
George D. Babcock. *Bulletin of the Taylor Society*, December 1924, v. 9, pp. 260-270. Gives a complete outline of the system of production control in use in the plant of the Holt Manufacturing Company.

Production Control. 658.51
(Control That Makes Possible Our 30-Day Turn.) H. R. J. Reiser. *Factory*, January 1925, v. 35, pp. 62-65. The application of a dispatch rack and other equipment in reducing manufacturing costs.

Production Schedule Aids Steel Foundry Sales. 658.51
Bert Ulehake. *The Foundry*, January 15, 1925, v. 53, pp. 49-51. Illus. Outline of production control system that enables a jobbing plant to keep its shipping promises.

Sand Blasting Cuts Cost of Cleaning Many Kinds of Automotive Parts. 658.5
P. M. Heldt. *Automotive Industries*, January 22, 1925, v. 52, pp. 142-146. Illus. Its application to various industrial cleaning operations.

Employment and Personnel Management

Employment and Training

Industry's Interest in Industrial Training. 331.86
Magnus W. Alexander. *Mechanical Engineering*, February 1925, v. 47, pp. 94-96. States the need for vocational training and estimates that at least 390,000 more apprentices should be in training than are at the present time.

A Modern Apprenticeship. 658.3861
H. A. Frommelt. *American Machinist*, January 22, 1925, v. 62, pp. 145-148. Illus. Outlines the organization of apprentice training in the works of the Falk Corporation. There are five classifications ranging from regular apprentices, employees of 16 years of age, to university graduates. There have been nearly 1000 enrollments during the last four years.

Public Employment Offices: Their Purpose, Structure and Methods. 658.311511
Shelby M. Harrison and Associates. Russel Sage Foundation, New York. 685 pp. $3.50. The fact that an average of from 10 to 12 per cent of all workers in the United States are out of work all the time impelled Russel Sage Foundation to institute an investigation, of which this book is a report, into present employment methods and their value in planning for future development. The first part of the book discusses the agencies now used in employment work and evaluates their service. The second part discusses the general organization and administration of a nation-wide employment service. Part III deals with the organization and operation of the local employment office. The fourth section takes up methods of dealing with workers requiring special kinds of service such as junior, farm, negro, and immigrant.

Training Clerical Workers. 658.386
Earl B. Morgan. *American Management Association Bulletin*, pp. 8-15. Methods used by Curtis Publishing Company for training Elliott-Fisher Bookkeeping Machine operators.

Training for Industry and the Public Program of Vocational Education. 331.86
Frank Cushman. *Mechanical Engineering*, February 1925, v. 47, pp. 98-101.

Training Office Employees. 658.386
H. M. Jefferson. *American Management*

Association Bulletin, pp. 3-8. Methods, cost, and results of training school.

The Value of Photographs and Handwriting in Estimating Intelligence. 658.31156
Katherine T. Omwake. *Public Personnel Studies*, January 1925, v. 3, pp. 2-15. Charts. Results of a series of tests which tend to show that photographs and handwriting are of no practical value in estimating intelligence.

Personnel

American Management Association Convention. 658.3
MANAGEMENT AND ADMINISTRATION, March 1925, v. 9, pp. 275-276. Cost and expense allocation of personnel work; improvement of policies, identity of personnel administration and management were features discussed.

The Control of Output in Offices. 651
Wallace Clark. American Management Association Pamphlet, New York. 12 pp. Principles and mechanisms.

The Foreman's Magazine. 331
January 1925, v. 1. First issue of official organ of The Ohio Federation of Foremen's clubs. Contains news items and articles of interest to foremen.

The Functions and Possibilities of Works Councils. 658.31513
Eric N. Simon. *Mechanical World*, January 23, 1925, v. 77, p. 57.

The Growth of American Trade Unions, 1880-1923. 331.88
Leo Wolman. National Bureau of Economic Research, New York. 170 pp. $3. The present volume is a logical result of the first task undertaken by the Board. This was to collect and present data concerning the size and distribution of the income produced and consumed in the United States, and why it continually fluctuates. Wage earners are much the most numerous class of income receivers, and the trade-union movement exerts a strong influence on both productivity and wages—therefore on the national income. So this study of the changing membership of trade unions and proportions of wage earners thus employed is of considerable value in analyzing causes and effects of national income fluctuations.

Industrial Relations Plan Stands Time Test. 658.3151
Gilbert L. Lader. *The Iron Age*, January 29, 1925, v. 115, pp. 325-330. Illus. Organization, operation, and results of plan used by Colorado Fuel and Iron Company.

Labor's Growing Share in Management. Is It Effective? 658.3151
Factory, January 1925, v. 35, pp. 29-32. Experience of a number of executives in regard to the effectiveness of works councils and similar management-sharing plans.

Let Your Workmen Think—It Pays! 658.3147
W. E. Onion. MANAGEMENT AND ADMINISTRATION, March 1925, v. 9, pp. 259-260. Illus. Operation and results of suggestion system used at Schenectady plant of General Electric Company.

Office Etiquette for Business Women. 658.314
Ida White Parker. The Ronald Press Company, New York. 87 pp. $1.25. On account of the great number of young women now entering business concerns, there is a need for some clarification of the rules of etiquette as applied in offices. Office managers find that it pays to give some attention to the training of employees in matters of etiquette. For this purpose as well as for use by business women interested in self-improvement, the present book constitutes an authoritative manual on the subject.

Personnel Administration: A Bibliography. 658.3(016)
Compiled by William H. Rossi and Diana I. Powers-Rossi. Williams and Wilkins Company, Baltimore. 365 pp. $5. During recent years there has been a vast amount of material published on the subject of personnel administration. This has been widely scattered in books, pamphlets, periodicals and official reports, so that a student of the subject experienced difficulty in locating all important titles on any particular phase. This book contains a list of titles published during the period from 1919 to January 1924. About 2750 titles are included, arranged under subject headings for ready reference. An index of authors and of publications is also included. Although this list is not complete, it contains all the more important titles on each subject, enough certainly to present any personnel administrator with a practical working knowledge of the current literature on any subject.

Relation of Machines to Labor Turnover. 658.3126
Russell B. Williams. *The Blast Furnace and Steel Plant*, January 1925, v. 13, pp. 5-8. Illus. Examples showing influence of installation of mechanical equipment on employees.

Sharing Management With the Employees. 658.3151
Mary Van Kleek. *Iron Age*, January 22, 1925, v. 115, pp. 273-274. Gives an outline of the employee representation plant at the Dutchess Bleachery, Inc.

Supervision. 658.3124
Howard Lee Davis. American Management Association Pamphlet. New York, 10 pp. Requirements for selection and training of supervisors.

Union Labor. 331.88
(Is a New Viewpoint Toward Organization Justified?) *Factory*, January 1925, v. 35, pp. 37-38. A review of labor conditions including union membership, employment, immigration and wages.

A Voice in the Management. 658.3151
M. E. Nicholls. *Mechanical World*, January 2, 1925, v. 77, p. 7. More attention should be paid to the human side of industry, but giving workers "a voice in the management" is impractical and unnecessary.

Safety

Industrial Safety. 658.3823
(What Industry Thinks About Safety.) *Factory*, January 1925, v. 35, p. 43.

Practical Safety Devices for the Bolt Factory. 658.283
Arthur L. Greene. *National Safety News*, February 1925, v. 2, pp. 9-10. Illus.

Safe Operation and Use of Crane Chains. 658.3823
A. V. deForest. *National Safety News*, February 1925, v. 2, pp. 23-24.

Safety in the Operation of Pulverized Fuel Systems. 658.3823
Mechanical Engineering, February 1925, v. 47, pp. 115-117. Report of a fire in a coal-pulverizing plant and a summary of lessons drawn therefrom.

Wages

How Workers Can Secure Higher Salaries. 331.215
Sir Ernest Benn. *Gas Age Record*, January 17, 1925, v. 55, pp. 83, 104. Wage increases should be based upon increased production and not upon increased cost of living.

The Principles and Technique of Preparing a Plan of Compensation for Positions and Employees in a Large Organization. 658.32
Edwin O. Griffenhagen and Fred Telfard. *Public Personnel Studies*, January 1925, v. 3, pp. 16-25. Forms.

Profit-Sharing as a Method of Compensation. 658.324
Official Bulletin—National Association of Cost Accountants, February 1925, v. 6, pp. 3-15. Summary of investigation of profit-sharing viewed as a method of industrial compensation and examined in the light of present-day business practice and methods.

Financial and Accounting Control

Accounting and Cost Finding

Accounting Principles Underlying Federal Income Taxes, 1925. 657.458
Eric L. Kohler. A. W. Shaw Company, Chicago. 550 pp. $5. Contains an exposition of present income tax law and how it has been interpreted by the courts and the Treasury Department. The latter has been obtained by presenting summaries of several hundred cases that have been adjudicated, by means of which any taxpayer can determine the prevailing tendencies of judicial bodies and also the trend of accounting theory. The seven main sections of the book cover methods of accounting; income from sales and exchanges; other income; deductions; in-

vested capital; rates of taxes and returns; and applicability of income taxes.

Cost Accounting Increases Profits. 657.452
G. M. Pelton. MANAGEMENT AND ADMINISTRATION, March 1925, v. 9, pp. 271-274. Cost accounting should be a service to aid in operation.

Costs for Executives. 657.452
N. A. Hall. *Industrial Management*, January 1925, v. 69, pp. 24-27. Discussion of standard costs.

Depreciation Deductions for Furnaces and Machinery Under the Income Tax Law. 657.42
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295-310

MANAGEMENT
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ADMINISTRATION
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German Finance and Industry

321

Conditions That American Manufacturers Should Know

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CERTAIN conditions obtaining in Germany today are worthy of consideration, in order to understand the tremendous improvement which has taken place during the past year in the German financial and industrial situations, and because a knowledge thereof is essential to anyone who may be affected by further changes of magnitude which must still take place in order that Germany may effectively compete in the world markets.

In November 1923 the stabilization of a new issue of German currency, with the "rentenmark" as a basis, was effected. The "reichsmark", introduced under the Dawes plan, is now the official basic currency unit, as the issue of the rentenmark was discontinued some months ago. Both currencies are officially recognized as of equal value (4.2 marks per dollar) and are used interchangeably; they are quoted on the various exchanges at the pre-war value of the mark, i.e., 23.8 cents.

The January 31, 1925, statement of the Reichsbank, the bank of issue, showed a gold reserve with respect to circulation of 43.9 per cent and a total reserve of 58.5 per cent including both gold and foreign exchange. An important factor in the maintenance of such reserves by the Reichsbank has been the proceeds from the German government loan in America, of which Germany has already received $42,500,000, including the $2,500,000 in gold, shipped by J. P. Morgan and Company a day or two ago (February 9, 1925). Confidence in the stabilized currency at home and abroad has even brought about a renewal of the savings habit, as the year 1924 showed a very satisfactory increase in savings bank deposits. Recent bank and governmental graft scandals have, however, temporarily affected this confidence, but it will be restored.

Interest rates for borrowed money were very high during 1924, reaching their high point during May and June, when the German banks charged from 5 to 7 per cent per month interest. Today the rates quoted are from 10 to 13 per cent per annum for daily or monthly reichsmark loans; dollar and sterling loans are quoted at 7 to 7½ per cent per annum. Further improvement in interest rates is looked for in the future. Of importance in connection with the easing of the German money market are the large industrial loans recently placed in America, of which more are expected; the financing syndicates in process of formation in England for the specific purpose of financing German industries, and the short-term credits extended abroad to German buyers.

During the inflation period many industries paid off their loans, and invested any remaining liquid capital, in so far as it was possible to do so, in materials, equipment and buildings. The result is that many of the industries are operating today partly on the proceeds of the inventories which were on hand at the time the stabiliza-

tion was accomplished, partly on new bank loans, for which they are paying interest at rates too high to be borne profitably, and partly on credits extended to them by suppliers in other countries, principally America. It is estimated at this time that the short-term credits of the nature just referred to, extended by American suppliers, aggregate not less than $125,000,000, and that they are carrying an average interest rate of approximately 5 per cent per annum. If the present outstanding acceptances are met at maturity, a decided increase in this method of financing American exports to Germany may be looked for, as America desires this export business and the carrying cost to German manufacturers is much lower than the cost of local borrowings.

Recent German Loans in America

Within the past few weeks a number of Germany's largest and richest corporations have secured funds through the sale of bonds or notes in America, but in some of which Dutch investors also participated. With one exception these were all covered by either merchandise collateral or mortgage, and in every case the borrowers were not only long established and foremost operators in their line, but concerns whose aggregate annual export business in normal times or at present is in volume much larger than the annual requirements for interest and amortization of the loans. Such borrowers will be in much more advantageous position to take care of their foreign loan obligations than will those who must purchase foreign exchange in the open market for that purpose, where competition will be had not only with normal purchasers, but also with the Reparations Commission, which will continually require large amounts of foreign exchange. Nevertheless, additional offerings to American investors of securities of large German industrial corporations are probable. Through the medium of holding corporations formed especially for the purpose of holding mortgages from its members and issuing one obligation for a large foreign loan (the proceeds of which will be allocated among its membership) many manufacturers of similar product hope to obtain liquid capital from abroad, which none of them could obtain directly because of their comparatively small size and their lack of international reputation.

Prospect of German Loans Abroad

There is every indication that there may be a flood of provincial and municipal German loans made abroad. The only check upon this financing, however, happens at the moment to be a very effective one, in the shape of a special National Commission, without the approval of which no such loans can be legalized. Provinces or municipalities which own industries from which income can be used to cover interest and amortization, will probably have little difficulty in securing such approval. The *Sächsische Industrie* loan is a case in point, where the obligation is that of industries whose capital stock is owned entirely by the state of Saxony and which state is understood to have guaranteed the payment of the entire loan and interest.

By national decree, all corporations were required to file balance sheets upon the basis of gold mark valuations as at January 1, 1924. While extensions have been granted from time to time, the latest date now set being March 31, 1925, most of the corporations whose securities are listed upon the Berlin Bourse have filed such balance sheets. A scrutiny of the present capital (scaled down to cover gold mark valuations of assets and liabilities) of about 700 of such concerns, is illuminating. The capital prior to the restatement was upon the basis of inflated currency, and in many cases was from 2 to 35 times greater than the pre-war capital. The scaling down of the valuations to the gold mark basis naturally showed very large shrinkages, resulting in a loss of from 50 to 95 per cent of such inflated capital. However, these shrinkages are not so serious as would at first appear, as a comparison of the present restated capital with the pre-war capital indicates that in very many cases the present capital is even higher.

It should be borne in mind, however, that prior to the war, German banks and industries wrote off their buildings and fixed assets, so that their value appeared on the balance sheet at very nominal figures, whereas in many cases these values had to be restored, when restating the capital in 1924, to make a decent showing. On the other hand, it was to the advantage of German institutions to show as little invested capital as could be reasonably shown, as thereafter dividends can be paid upon such comparatively small capital even when the earnings are not large. This fact, and a desire to keep the property tax down to a minimum, resulted in low valuations wherever possible without entirely wiping out the capital investment on the restated balance sheet.

It is apparent that, as a whole, German industry is in as favorable a position as before the war, that its investments in plant and equipment, while in many cases not modern, have not shrunk, and that working capital is the principal need today.

Taxes and the National Budget

Contrary to popular belief in some countries, German industry today is heavily taxed. Its most burdensome direct taxes are the Turnover Tax (formerly 2½ prior to 1925 and now 1½ per cent) the Property Tax, the Tax on Wages, on Capital Movement and on Anticipated Income. The last mentioned is not really an income tax since it is based on sales volume and not on profits. It not infrequently happens that those who actually have losses are paying income taxes. These direct taxes aggregate a total of from 5 to 7 per cent of gross sales volume. Then there are other direct and indirect taxes, among which are those of from 10 to 20 per cent on wages and salaries (deductible at the source), on individual income, on wine and other articles of consumption classed as luxuries.

All of those mentioned are national taxes, mostly of an emergency nature or directly due to effects of the war. In addition to these burdens are the state and municipal taxes, and although not high in rate but

affecting every industry and individual, the social taxes, such as health and old age pensions.

The industries are selling abroad without profit to meet competition, and an effort is now being made to relieve industry of practically all taxes on business done in foreign commerce. The workman groans under a burden of taxes which leave him not even a living wage, and those taxes are certain of amelioration.

Prospects of Tax Reduction

At the outset of the stabilization period no one could reasonably estimate the amount of taxes which would be collected upon a gold mark basis, and the one aim was to cover the national budget. Not only was this accomplished, but such an excess of tax income was produced, that large sums have been recently paid as indemnities to German industries in the occupied territories, and it is only too clear to the people that taxes can be reduced, and that legislators will be compelled to reduce them. Whether or not such reduction can be accomplished to an appreciable extent during 1925 depends largely upon what political action is taken upon the question of valorizing a certain percentage of the national, provincial and municipal bonds which were practically wiped out during the inflation. German holders of mortgages and industrial securities, and German depositors in savings banks, subject to certain limitations and regulations, will probably recover about 15 per cent of their losses through valorization already provided for. If legislation is enacted similarly to reimburse former holders of securities of the national government and of political subdivisions, the reduction of taxes will be a slow process.

TABLE I. IMPORTS AND EXPORTS

(In 1000 Gold Reichsmark)

	1923	1924	Increase (– Decrease)
Imports:			
Live stock	32,542	92,467	59,925
Food and beverages	1,203,725	2,676,934	1,473,209
Raw materials	3,106,878	3,686,786	579,908
Semi-finished mdse.	806,016	897,654	91,638
Finished mdse.	920,391	1,781,213	860,822
Gold and silver combined	11,839	181,787	169,948
	6,081,391	9,316,841	3,235,450
Exports:			
Live stock	3,122	13,713	10,591
Food and beverages	131,367	419,142	287,775
Raw materials	367,499	468,089	100,590
Semi-finished mdse.	362,670	439,091	76,421
Finished mdse.	5,199,731	5,191,418	– *8,313*
Gold and silver combined	14,765	35,401	20,636
	6,079,154	6,566,854	487,700
Excess of imports over exports	2,237	2,749,987	2,747,750

A comparison of Germany's 1923 and 1924 imports and exports is shown in Table 1.

Food, beverages and finished merchandise are largely responsible for the heavy increase of imports during 1924; while raw materials were also a contributing factor, their export also increased during 1924. It is interesting to note that, while the gross importations of raw material during 1924 exceeded those for 1923 by nearly 580 million reichsmark, the total finished merchandise exported during 1924 was less than during 1923. While published figures are stated to include those for the occupied area, the writer doubts if such figures are entirely reliable; nevertheless it is probable that the relations of imports to exports would not be seriously affected by any adjusted figures, none of which are now available.

In German financial circles this condition is giving great concern, and every effort is being made to increase exports since it is not believed possible to reduce the imports greatly, except possibly with respect to the items of beverages and finished merchandise. Germany must always import food, and efforts to control imports of finished stock have taken the shape of limited embargoes on such goods as Germany can produce.

Germany must bring her exports up, not only to balance her imports, but far to exceed them if she is to meet her obligations under the Dawes Reparations Plan and to take care of the interest and amortization charges on her foreign industrial loans and of the current maturities on her short-time credits.

Germany is bending every effort to recover her prewar markets. The tariff has made the United States of America a much more limited market for Germany than before the war, and Russia is no longer the large outlet she once was. Germany at present is exporting principally to South America and Asia; she is developing what business she can get in Russia and in the English territories and multiplying her sales to the smaller countries, which collectively are not to be considered an insignificant market. Commercial treaties with the larger world powers are still under consideration, and their conclusion may open markets in which Germany now can make only limited sales. Large Russian orders in exchange for exploitations are not an improbable development of the future.

Germany must have exports at whatever cost. She is already selling in some foreign markets at no profit, and in many cases at prices less than sold for home consumption. It may be that she will adopt the policy which some of the smaller newer nations of Europe for a time followed, of exporting at even less than cost of production in order to secure exchange to meet foreign obligations. She anticipates that anti-dumping laws in all the larger countries may cause trouble in this regard.

German Industrial Production and Costs

German industry is at the present time, with a few exceptions, working at capacity or close thereto. The larger portion of the product is, however, for home consumption, and if the cities and provinces secure loans of sufficient amount to undertake the extensions of public improvements and renewals of public service facilities which ought to be undertaken, a shortage of manufacturing labor would not be surprising. Some of the industrial loans made abroad doubtless will be used for modernizing production equipment. Capacity operations, the modernizing of equipment and lower taxes will reduce costs. Consolidations may also be looked for in a further effort to press down costs to a

point where competition in the export field can be successfully met.

America's concern has always been that Germany could produce cheaply because of very low wages. The German workman today receives approximately as many reichsmarks as the American workman does dollars. From this it will be seen that the German labor-cost today would be about one quarter that of the American labor-cost, if the individual efficiency were approximately identical. However, the German has little incentive to be efficient since the cost of living is, with the exception of rent, the same in Germany today as in the United States. Wages must be raised, and the cost of living must be reduced. Manufacturers expect to increase wages, and stringent measures looking toward the reduction of cost of living may be expected. There are indications that, in spite of low wages, the German is again starting to save. When he sees that he can make some headway, the efficiency of the German workman will doubtless increase and this will have the effect of lowering the cost of production. The banks' restriction of loans will result in cutting of the overhead expense, which is greater than in American factories.

German Competition

The accomplishment of the lower production costs through the reduction of taxes, the increasing of efficiency to more than offset the necessary and certain increase in wages, the modernizing of equipment and the reduction of financing cost, cannot be done during the period of a single year. In fact, it is doubtful if they can be done within five years to such an extent as to bring German costs down really to compete in America with local manufacturers there. The financial and industrial interests who are about where they were prior to the war or who have lost much through the inflation period, want to make the profits which they should have made or recuperate their losses, as soon as possible, and it may even be that some of the readjustments of living conditions and wages in Germany will not be accomplished without unpleasant experiences. Germany's future, however, lies in its industrial rehabilitation. Its currency is now stabilized; its factories are, with exceptions of some lines, running almost at capacity and they can be expected to continue so to run for some time; its credit is being quickly restored and internal adjustments with respect to equipment, taxes and labor are the present problems which must be met and satisfactorily adjusted shortly. If the labor cost continues low, and Germany succeeds in slashing the cost of living and taxes, her costs, even without completely modern equipment, will soon be down to a competitive basis. In industries where labor forms the principal item of cost, she is only prevented today by the tariff wall from competition with American manufacturers in the United States. But wages must go up and the costs will go up also, and the greatest danger to American industry is believed to lie principally in the possibility of Germany dumping her goods in whatever market she can place them, if not actually at less than production cost, then certainly below the prices at which sold for home consumption.

International Welfare Congress

THAT the subject of industrial welfare is becoming of world-wide interest is evidenced by the fact that an International Industrial Welfare Congress is to be held this summer in Flushing, Holland, from June 20 to June 26. This meeting is the outcome of an informal conference held in 1922, when representatives of 11 countries met to discuss their mutual problems in connection with industrial welfare. So much interest was expressed at this meeting, and, in spite of inevitable variation in details, so much harmony and unity of purpose were evident, that a committee was appointed to carry on the work of the conference.

Secretarial headquarters were installed at Leerdam, Holland, with M. L. Fledderus as secretary. Contacts established at the conference have been maintained and new contacts made that have been convincing evidence of the widespread interest in the subject of international industrial welfare. As a result of the work of the Secretariat during the past two and a half years, the congress proposed for this summer has been organized.

An article dealing with the development of the movement for industrial welfare in those countries where contact has already been established, has been prepared by the Committee and published in the July 1924 issue of *The International Labour Review*. This article has been reprinted as a separate brochure in English, French, and German, and has proved of great value in helping the Committee to get in touch with those persons in other countries who are interested in industrial welfare.

Purposes of the Congress

Among the purposes of the congress will be the formation of an International Association to carry on the work of promoting human welfare in industry. The main subject to be discussed will be the determination of what constitutes really satisfactory human relations in industry. Each country has something to contribute to the solution of this problem so that this congress, which is anticipated to be widely representative of industrial countries throughout the world, offers unlimited possibilities in solving the human relations problems of industry.

The congress is open to all who are interested in the subject, or who are connected either directly or indirectly with industry. Additional information may be obtained from the secretary.

New Methods Cut Power Plant Costs

Savings of $67,200 a Year Made by Improved Operation

By C. E. KILLINGER

Vice-President and General Manager, The Willys-Morrow Company

IN 1922 a study of the power situation at the Willys-Morrow Company was made in connection with a general reorganization of plant administration and operation. The plant is engaged in the manufacture of complete transmissions and other parts for the Willys-Knight and Willys-Overland automobiles. The power house was used primarily to produce steam to operate 10 steam hammers in the forge shop, 3 air compressors, boiler accessories, two 1000-gal. fire pumps and the pumps furnishing water to the factory and office buildings. Only a small fraction of the electric power required to operate the various departments was generated in the plant. The rest was and is still purchased from the Elmira Water, Light and Railroad Company.

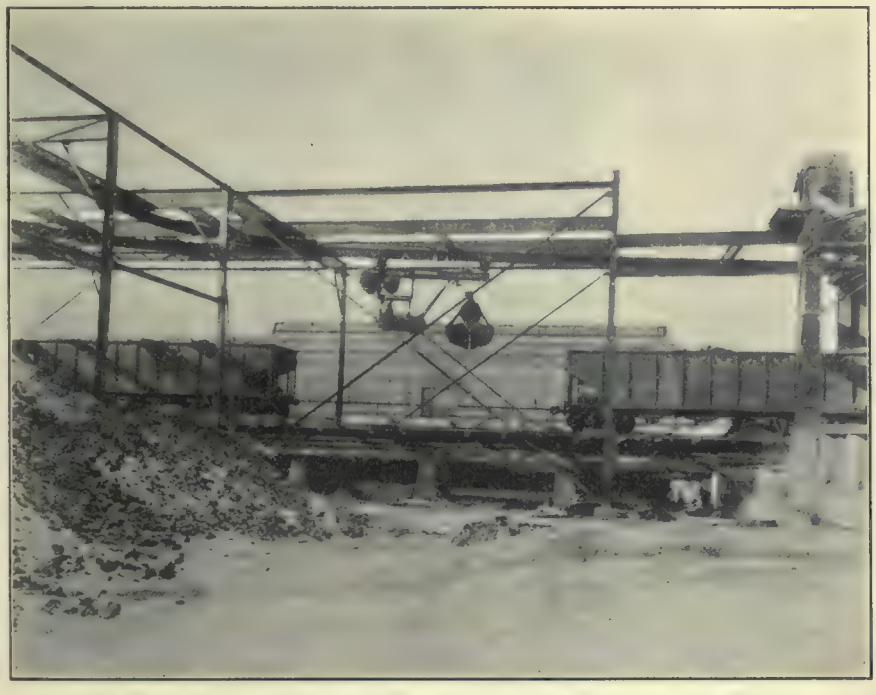

FIG. 1 MONORAIL HOIST, COAL HOPPER, CRUSHER AND ELEVATOR

In the boiler-room there were six 300-hp., Type S-15, Stirling boilers. Each was equipped with 2 Jones underfeed stokers (of an old model), a Bailey boiler meter, a Kitts feed-water regulator, and the usual gage and water column. A steam-operated ash-handling installation built by the American Steam Conveyors Corporation ran beneath the floor in front of the boilers. Feed water was supplied through a Cochrane heater.

Up to this time coal had been handled by manual labor. Side or bottom dump railroad cars had been run onto a trestle paralleling the boiler-room and at a height of 8 ft. above the floor line of boiler-room and yard level. From this point it was taken by wheelbarrow into the boiler-room, an average distance of 175 ft. away.

Here the coal was dumped on the floor in front of the boilers and fed to the stokers by hand shoveling. One fireman attended each stoker, each of the 5 boilers in service thus requiring 2 firemen. Over 12,000 tons of bituminous coal were consumed annually and 3 wheelers were kept busy almost continuously bringing it into the boiler-room. This work made it necessary to have the doors open most of the time, and, as the doorway was not sheltered from the wind, the temperature of the boiler-room was close to freezing during a good portion of the winter. In fact, unless care was taken, some of the piping, where water was present, would freeze.

Of course, conditions like these were not conducive to the best work, nor to the greatest economy of plant operation, and the problem facing the management was to rectify them as soon as possible. The men had got careless about watching the power plant instruments, and were running the fires by rule-of-thumb methods. Some of the instruments had been neglected and needed repairing before they could again be put into use. Evidently radical changes in equipment and operation were necessary.

Table 1 is a condensed summary of the report made out recommending new methods. The data compiled showed the following facts. The power plant was run day and night, as many of the shops were under production for 2 or 3 shifts. Each shift in the coal-handling gang numbered 10 firemen, 3 coal wheelers, a repair man, and a helper, the latter 2 on the day shift only, or a total of 15 men. Beside these, there was an engineer in the engine room day and night.

Clearly here was an opportunity to introduce coal-handling equipment and probably save money by reducing labor. A survey was made and plans were outlined to this end. It was decided that a complete

installation was necessary and that it should provide for storing coal as well as getting it into the power house. This installation was completed during the latter part of 1923.

The trestle formed the starting point of operations. (See Fig. 1.) A steel track hopper 14 ft. square was put in below the trestle, at the corner of the boiler-room. Beneath this hopper was installed a coal crusher to reduce the coal to 1¼ in. size or less, and, connected with it by chute, a bucket elevator was erected in a casing outside of the building. The upper end of the elevator discharged onto a drag conveyor, which was rigged with control gates to empty into overhead coal bunkers. From the bunkers coal was fed directly to the stokers, where it was measured by Peterson coal meters.

Hence, when a carload of coal is received, it can be dumped directly into the track hopper, crushed, and put into the bunkers without any manual labor except one man to clean up the car, or two men in winter when the coal is frozen. Seventy tons have been fed into the bunkers in 1¼ hr.

The coal-handling equipment above described was designed and built by the Webster Manufacturing Company. It has been in operation over a year and has released 11 men for other work. More steam is generated per day with 2 firemen and one ash handler per shift, and one repairman for day work only, than was produced with a total of 15 men per shift in the boiler-room under hand methods. In addition, the work has been greatly lightened for those who are left, and the boiler-room is kept at a comfortable temperature because the doors are not opened to cart in the coal. The increased efficiency of plant operation will be taken up later.

In summer it is necessary to store up coal for winter needs. To do this economically a monorail system of handling was designed and erected by the Seneca Engineering Company. (See Fig. 2.) A concrete pit approximately 100 ft. long with sloping side wall was constructed underneath the trestle in such a manner that the sloping side wall would carry the coal dumped from a hopper-bottom coal car to a point parallel with the track, so that it could be easily picked up by a Hayward bucket. This bucket is operated by a Shepard 3-ton monorail cage-operated electric hoist which travels on a framework of I-beams extending about 100 ft. at right angles to the switch track, so that coal can be stored and reclaimed from an area of 80 x 100 ft.

When it is necessary to store coal, the car is dumped, not over the hopper and crusher, but further toward the end of the trestle, into the pit. The monorail hoist then picks up this coal by means of the bucket and carries it out to the desired point in the storage pile.

The hoist clears the coal cars and hence can be operated at the same time that cars are on the trestle for dumping. As much as 5000 tons of coal have thus been put into storage at a time without any demurrage charges on the cars. In fact, the unloading operation is so quick that often the locomotive is not uncoupled, but waits for a car to be emptied.

The reclaiming operation is as simple and quick as the storing. The hoist picks up a bucket load of coal from storage and travels across the overhead switch onto the track above the trestle, to a point over the hopper. Here the load is discharged and feeds through the crusher, elevator and drag conveyor to the overhead bunkers in the boiler-room. (See Fig. 3.) One man, the crane operator, handles 65 tons of coal in 2¼ hr. by this method, or at the rate of 29 tons per hour.

FIG. 2 OVERHEAD TRACK FOR STORING AND RECLAIMING COAL

Other improvements were necessary in the power plant before it could be efficiently run. The advisability of replacing the old stokers with new model Jones underfeed stokers of the side-dumping type was evident at once. Instead of 2, however, each boiler was equipped with only one. The power plant instruments were thoroughly overhauled, cleaned and repaired, and the men were carefully instructed in their use. Now these instruments, especially the Bailey meters on the individual boilers, are watched very closely and used as guides to keep steam up economically.

Gage pressure is now maintained at 135 lb. where previously it was 100 lb. Four boilers are operated and 2 shut down, where formerly 5 were run. The quantity of steam generated now averages 50,000 to 55,000 lb. per hr., with a maximum of 65,000 lb. over a 6 hr. period, as compared with 30,000 to 40,000 lb. per hr. under previous methods. A Bailey meter on the steam line records this output.

The main use for steam under pressure is to operate the drop forge hammers in a shop approximately 1000 ft. away. There are two 1000-lb., four 1500-lb., and

TABLE 1. COMPARISON OF POWER PLANT OPERATING COSTS

Condensed from report showing actual operating costs with old equipment and methods, and estimated costs after changes have been made.

ACTUAL COSTS DURING JANUARY–DECEMBER, 1922, INCL.

Fuel consumed:		
Coal, tons	11,593	
Coal equivalent of fuel oil	737	12,330
Cost of engine-room labor		$ 5,694.00
Cost of boiler-room labor		$21,403.20
Cost of coal handling (estimated)		4,066.00
Total cost of boiler-room and coal handling. (This does not include supplies and tools)		$25,469.20

RECOMMENDATIONS

Replace old stokers with new to eliminate coal handling and to give combined efficiency of 74 per cent to furnace and boiler.
Install coal-handling system consisting of:
- Track hopper 14 ft. square
- Coal crusher to reduce lumps to 1¼ in. size (with by-pass in case coal does not have to be crushed)
- Bucket elevator
- Drag conveyor
- Coal bunkers above boilers, 200 tons capacity
- Chutes to stoker hoppers, the latter of 500 lb. capacity
- Monorail hoist and overhead structure to handle coal for storage. Hoist capacity 3 tons. Equipped with 1½ cu. yd. Hayward bucket holding 1 ton of coal. Rating of hoist 30 tons per hr. from storage to coal hopper and thence to bunkers.

COST OF PROPOSED EQUIPMENT

		Installation	*Total*
Stokers	$ 4,242	$900	$ 5,142
Coal conveyor system	13,804	3,560	17,364
Monorail hoist	5,890	2,700	8,590
Total cost			$31,096

ESTIMATED COST OF COAL HANDLING AFTER CHANGES ARE MADE

Delivering annually 12,330 tons of coal to stokers:	
Rate of handling	200 tons per 8½ hr. day
Men required on car	2
Labor cost, 200 tons, per day	$ 7.65
Labor cost per ton	0 0383
Depreciation (10 per cent) and interest (6 per cent), per ton basis	0.2300
Total handling cost per ton	$0.2683
Total handling cost per yr.—12,330 × $0.2683	$3308.13
Storing and reclaiming 3760 tons of coal annually:	
Labor cost, per ton	$ 0.025
Depreciation (10 per cent) and interest (6 per cent), per ton basis	0.306
Repairs, per ton basis	0.015
Total storage cost per ton	$ 0.346
Total storage cost per yr.—3760 × $0.346	$1300.96

ESTIMATED COST OF OPERATING BOILER-ROOM AFTER CHANGES ARE MADE

In winter:	
Day shift—2 firemen, 1 helper.	
Night shift—Same.	
In summer, and on Sundays and holidays:	
Day shift—2 men.	
Night shift—1 man.	
Total annual boiler-room cost	$ 7,956
Total annual operating costs for coal handling and boiler-room—$3308.13 + $1300.96 + $7956	$12,565.09
Total annual savings in operation—$25,469.20 − $12,565.09	$12,904.11

three 2000-lb. drop forge hammers in this building and one 4000-lb. steam hammer, and they take an average of 20,000 and a maximum of 30,000 lb. of steam per hr. Until the power plant was put on an efficient basis, the exhaust from the forge hammers was wasted, except for a small quantity used in the pickling room and to heat the forge shop office. A heavy demand from this shop meant more work on the part of the boiler-room crew, and they were sometimes kept hustling to maintain 100 lb. pressure in the line. Part of the trouble was leaky boiler settings and scale in the boiler tubes, both of which were promptly remedied as soon as the power plant investigation disclosed them.

An unused 8-in. pipe line ran over to the forge shop along with the main steam line and a water line. Hence it took but little work to connect the exhaust from the forge hammers to this line and return the steam to the power house. The exhaust from the engine and boiler-room steam-driven equipment was already in use for steam heating, and the 8 in. line from the forge shop was connected into this system for the same purpose. Any additional steam needed for the heating system is obtained from the main high-pressure steam line through a reducing valve.

Thus, the power for the forge shop now costs only a small per cent of its former cost, or, looked at from the other standpoint, about 40 per cent of the steam required for heating is obtained without cost from the forge shop, and the balance required is obtained mostly from engine room exhausts. (In summer forge shop exhaust must, of course, be wasted.) Under the old plan, the forge shop was a cause of trouble to the power plant. Now the power plant registers a kick if there is less demand for steam from the forge shop.

In the engine room there is a unit which is of an unusual type. It is an air compressor built by the Nordberg Manufacturing Company and driven by a horizontal, cross-compound Corliss type steam engine. The compressor itself is a 2-stage (high- and low-pressure cylinders) machine. The high- and low-pressure steam cylinders are built tandem on the high- and low-pressure air cylinders respectively, the high- and low-pressure sides in turn being connected to the cranks on the opposite ends of the crankshaft on which is also mounted a Westinghouse synchronous motor unit. This unit is a 300-kva., 220-volt, 3-phase, 60-cycle machine.

In the summer it was formerly the custom to shut down the engine driving this Nordberg unit and operate

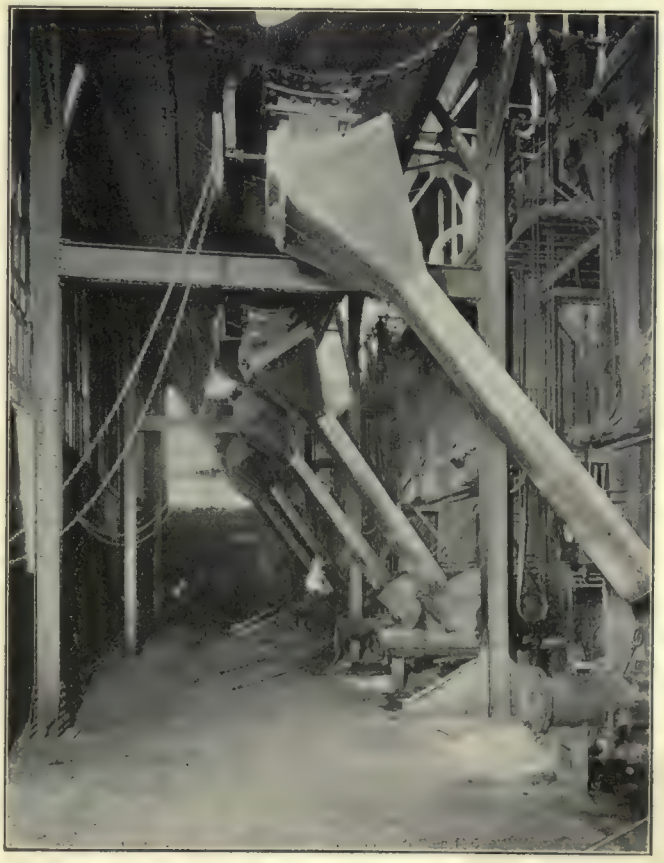

FIG. 3 FIRING AISLE SHOWING OVERHEAD COAL BUNKERS

it by the motor. As there was no demand for exhaust steam for heating during the warmer months, and as the unit was not equipped with a condenser, this seemingly was the most economical method of operation, as it permitted the shutting down of one boiler. The air compressor unit was installed in April 1920, and at that time the relative costs of coal, labor, maintenance, outside current, etc., indicated motor drive as the least

TABLE 2. COMPARISON OF OPERATING DATA ON STEAM-ELECTRIC AIR COMPRESSOR UNIT

Electric power consumed to operate compressor by motor:	
May, 1921	46,100 kw-hr.
June	71,000 "
July	60,000 "
August	72,000 "
Total	253,100 kw-hr.
Total days compressor was operated by motor	118
Daily power consumption—$\frac{253,100}{118}$	2145 kw-hr.
Hourly power consumption—$\frac{2145}{8.5}$	252.3 "
Average cost of steam per 1000 lb.	$0.65
Cost of steam per hour to operate compressor non-condensing—400 hp. × 21 lb. per i.hp. hr. × $0.65 per 1000 lb.	$5.46
Cost of steam per hr. to operate compressor condensing—400 hp. × 13 lb. per i.hp. hr. × $0.65 per 1000 lb.	$3.38
Cost of electricity per hr. to operate compressor—252 kw-hr. × $0.02	$5.04
Generated electricity when compressor is steam driven:	
October, 1922	21,700 kw-hr.
November	26,000 "
December	22,000 "
January, 1923	27,600 "
February	17,700 "
March	23,000 "
Total	138,000 kw-hr.
Number of days operated	143
Average kw-hr. generated per day—$\frac{138,000}{143}$	965.03
Average kw. generated per hr.—$\frac{965}{8.5}$	114
Value per hr. of generated electricity—114 × $0.02	$2.28
Estimated standby losses per hr. (coal for banked fires, plant upkeep, labor)	$1.22
Number of hr. standby—24 − 8.5	15.5
Cost of standby losses per day—15.5 × $1.22	$18.91
Cost of standby per hr. of actual service—$\frac{\$18.91}{8.5}$	$ 2.23

SUMMARY OF OPERATING COSTS

Steam-driven, non-condensing:		
Steam cost, per hr.	$5.46	
Standby cost per hr.	2.23	
Total cost per hr.	$7.69	
Value of generated electricity per hr.	2.28	
Net cost of operation per hr.		$5.41
Steam-driven, condensing:		
Steam cost per hr.	$3.38	
Standby cost per hr.	2.23	
Total cost per hr.	$5.61	
Value of generated electricity per hr.	2.28	
Net cost of operation per hr.		$3.33
Motor-driven, power cost, per hr.		$5.04
Savings per hr. running motor instead of using steam—non-condensing—$5.41 − 5.04		$0.37
Savings per hr. eliminating motor and using steam—condensing—$5.04 − 3.33		$1.71
Consideration of these figures shows clearly that it is more economical to operate the Nordberg steam-electric air compressor by steam, when the steam engine is run condensing.		
Estimated cost of condensing equipment		$2700
Estimated cost of installation		400
Total estimated cost		$3100
This cost will be repaid in 38 weeks of operation of the condensing unit.		

costly power for summer operation. But a re-calculation of costs during 1923 showed a decided loss in this method as compared with steam engine drive if the engine were run condensing.

The factor bringing about this economy is found in the action of the motor. When the air pumped into the receiver by the air compressor reached a pressure of 75 lb. gage, the air compressor automatically shut off and the engine normally would have run idle. But the synchronous unit mounted on the flywheel shaft was a potential generator, i.e., when driven by the engine during these periods when no air was being pumped, it would produce current. Hence this motor, connected up to the power lines, acted as a feeder to the system in the winter, while the engine was operating. In the summer, of course, it took power from the lines to drive the compressor.

Table 2 shows a summary of the report made recommending that condensing equipment be installed for this unit, to be operated during the warmer months, when exhaust steam was not required for heating, so that all the year round the engine would drive the compressor and intermittently run the motor as a generator.

A Burnham jet condenser and air pump have now been installed and will be operated as soon as the heating plant is shut down. They will improve the thermal efficiency of the plant, beside enabling the motor to be run as a generator the year round. Eventually about 5000 kw. of electric energy per 24 hr. will be generated. The record, non-condensing, during the first 20 days of January 1925 was an average of 3980 kw. per 24 hr. day, the plant operating on a 5½-day week.

TABLE 3. TYPICAL MONTHLY SUMMARY OF POWER PLANT COSTS

Coal	$ 9,744.30
Supplies—miscellaneous	102 09
Labor—boiler-room, engine room and coal handling	1,458.05
Repairs	530.08
Depreciation	1,075.00
Taxes	64 45
Insurance on property	30.14
Light	20.13
	$13,024.24
Steam generated, lb.	32,602,500
Cost (all charges included) per 1000 lb. of steam—$\frac{\$13,024.24}{32,602.5}$	$0.40

Based on a coal cost of about $4 per 2000 lb. ton, plus operating labor cost in the boiler-room, steam is now produced at a cost averaging $0.40 per 1000 lb., as against approximately $0.65 per 1000 lb. under former methods. This cost covers all the engine room charges as well as those connected with the boiler-room and coal handling. Hence it includes air compressing, water pumping, and the generating of whatever electric energy is fed to the line, and is not strictly a cost per 1000 lb. of steam as ordinarily understood. Table 3 shows a typical monthly calculation determining this overall cost.

The study made to improve the power plant has, therefore, resulted in a four-fold benefit. First, by installing coal-handling equipment, over $12,900 has been saved annually. By collecting all of the exhaust steam and using it for heating, about $90 per day is realized during the winter months, or $12,420 a year.

By putting in condensing equipment and using steam drive on the air compressor the year round, approximately $3500 is saved. The saving of $0.25 per 1000 lb. of steam generated means an economy of $51,335 per year, and taking from this the coal-handling savings $12,900, a net of $38,435 is attributable to better methods in power generation. The total savings are thus $67,255 a year.

Deserving a Manufacturing Profit

Work of the Industrial Executive—VIII

By B. A. FRANKLIN

Vice-President, Strathmore Paper Company

EVERY industrial executive and every owner in an industrial enterprise, whether in whole or in part, strives for and desires a profit.[1] This is the essential reason for ownership. But ownership is no longer, if it ever was, a warrant for profit, for profit must come from the public, and can come from nowhere else. The public is only willing to pay a profit for service, and, with the wider spread of industry, for the best service; therefore, essentially and fundamentally, industry is a service.

If industry is conducted as a service, then certainly the public must expect to reward that service, and the renderer of that service is entitled to expect a steady and reasonable profit, for that is the essential urge to begin and continue rendering service. There would be no reason for stating either of these expectations, since both are acknowledged by the public and industry, were it not well to set forth some simple and fair conditions as a proper basis for the fulfilment of these expectations, and some clarification of what constitutes rewardable service, which would create the deserving of a profit by industry.

Mr. Franklin, in this final paper on the work of the executive, discusses the final objective—profit. He declares that "industry is a service" and that profit is a reward paid by the public for service rendered. Many factors make up any service; each must have the attention of the executive. Quantity, quality, machinery, equipment, material, labor, process, price, marketing—the administration of all these must be effective to make sure that "a profit is deserved."

The public is demanding more and more service, in an increasing standard of living. Industry has grown and expanded in an attempt to meet this demand. This condition has come about, not because of any broad idealism or large concerted movement, either on the part of the public as a whole or of industry as a whole, although both represent mass movements. The advance of civilization in its control of natural laws and material conversion, the advance of government in its democratization and liberalizing of society and intercourse, have created a situation where mass movements by the public in consuming, and by industry in producing, have developed mutually, not as mass movements, but as individual movements reaching combined mass proportions.

The individual buys what he thinks he wants and can afford, and takes no account, in the buying, of any responsibility to keep industry or any industrial unit occupied, busy, or profitable. He thinks only of the particular article or service wanted, will change to another on slight persuasion of greater value, and is sure and content that a profit exists in the purchase price. It is only because there are so many individuals with wants that public buying becomes a mass movement.

On the other hand, the industrial unit is capitalized, constructed, and operated, not because any contract is made, or even expected, that the public will take its output. It is operated purely because those responsible think they can offer something which the public will buy in sufficient quantity, and at sufficient price, to give a profit. This condition prevents no other group from doing the same thing in the same, different, better, or worse way, even to overproduction. The whole proposition is voluntary on both sides. This is the strength and the progress of industry. The free chance and individual incentive in offering, together with the free opportunity of choice in buying, are the very soul of modern American industry.

This fact of development, however, creates the first and important condition under which the industrial executive operating an enterprise may expect to deserve a profit. Since he voluntarily undertakes a service to the public, and enters the field of competition, he must constantly make his service attractive to the public in quantity, quality, and price. He undertakes definitely, and without urge, to do what will deserve a profit from the public, against all fair competition.

To do this he must constantly consider or shape the public demand; educate the public he desires to reach; and keep himself informed of all of those things which have to do with the better rendering of his service in design, serviceability, methods, processes, inventions, improvements, and developments. The more completely he does this the more will he deserve and obtain a profit. The less he does it, the less he will deserve a profit, and, in point of fact, the more mediocre and profitless will his service become.

If the industrial executive is to meet this main condition of deserving a profit, as indeed he must to survive, he must meet it in the detail of the sub-conditions which it involves.

In the matter of quantity there are two big points to consider. First, an industrial unit, in undertaking to supply a given need or service, should carefully consider the quantity question from the point of view of that amount which it is necessary to produce to

[1] For preceding articles see MANAGEMENT AND ADMINISTRATION for September 1924, p. 249; October 1924, p. 391; November 1924, p. 513; December 1924, p. 611; January 1925, p. 21; February 1925, p. 149; and March 1925, p. 245.

bring about a cost below prevailing market prices, or certainly it cannot successfully compete, nor does it deserve a profit. Many plants find themselves in this condition through mere failure or ignorance in getting the facts. Their overhead eats up their profits, and forces them either to operate for a considerable period to build up a volume to a profit, or to succumb. More often than not it is the selling cost and not the producing cost which lack of quantity forces to too high a per cent to permit a profit. Between the small beginning with very low overhead, confined area sales, and satisfaction with small returns, and the large producing unit, lies a large field of industrial adventure where lack of capital is likely to be set down as the cause of failure, though the difficulty is really a failure to understand and calculate the quantity problem.

Second, there enter from time to time, into certain fields of production, industrial units with no understanding of the quantity needs of that field, with nothing new or improved, nor any new economy to offer, but merely with a desire to make a profit. If such an entry creates an overproduction, causing either the selling of goods at too low a price or the shutting down or running on short time of older plants, certainly that industrial unit can hardly be said to deserve a profit, for it must realize that the public is not merely a consumer. It is in the main also a producer, and suffers in its consumption when it suffers in its production.

The same solution may prevail in a plant already existing, which enters a new field without a survey of it. One expects a condition like this in a new neighborhood, where small grocery and candy and soda stores open up and operate on the basis of the survival of the fittest. But there is so much capital and the happiness of so many individuals involved in an industrial unit, that new entries should survey the needs and their present supply before attempting a service not needed, if they expect to deserve a profit.

Problem of Industrial Growth

It is true that the annually increasing needs of the public take care of this situation to a considerable extent. It is also true that the situation of overproduction frequently compels readjustments and improvements, and occasionally price reductions, bringing about resultant necessary economies which are in the interest both of the public and of the development of industry. Nor does it seem, in this age of expanding invention, development and industrial growth, wise to offer either prophecy or threat of an overgrowth. Industry still has great room for sensible growth. Nevertheless it ought to be an essential of profit-deserving that those who enter the field of industry shall have sufficiently surveyed it, either to know reasonably that they offer an improved service, or are needed to supply its quantity demands, if their expectations of profit are to be deservedly met.

The question of quality which must be faced involves a number of conditions. The buyer expects and, in the nature of fair service, is entitled to obtain the best quality in proportion to the price paid, for in these days of ethical business the wooden nutmeg is a vanishing article of merchandise. The industrial unit, by the very nature of its existence, expects to meet this public expectation. It is by this expectation that it expects to deserve a profit.

But it must be, in the first place, a matter of definite policy and plan of the industrial executive to produce quality, for quality is a matter of intention and plan. One large concern recently jobbed off $800,000 worth of underquality goods at what it could get for them, in order to make a right start with the proper quality. Its definite intention was crystallized.

Yet such an intention can hardly be carried out by that executive who makes no constant study of his materials. A consideration of almost any of the common articles in use will show that in the last decade or so there has been a decided change in the materials used. Steels of all kinds, the paper and tin bucket, steel furniture, holeproof guaranteed footwear, fast colors—all evidence a constant search for improved quality. It is the research laboratory which is creating the deserving of a profit through quality.

Quality Requires Skilled Labor

Quality is also a matter of skilled labor. This involves the selection and training of men, educating their ability, providing sanitary surroundings and health inspection, and maintaining fine working conditions, with good light, warmth and fresh air and clean surroundings. It involves also definitely set standards, insistence on their attainment and proper inspection. During the war there was great complaint that, in the ordnance material, the close tolerances in dimension of very many parts were unattainable, but the exactness was essential and, once insisted upon, was obtained and easily held. Standards, inspection, and insistence brought about the best workmanship. Those industrial executives who conceive and bring about this condition certainly deserve a profit.

Further, quality is a matter of machinery. Who does not prefer the loaf of bread delivered wrapped and untouched by hands in its process of manufacture? Quality can hardly be expected of even the most skillful workmanship from dirty or worn machinery. New, more effective, and exact machinery is constantly being developed, and that industrial unit which keeps its equipment up to date would seem to deserve most the profit that it is apt to obtain.

Also under the head of quality must be considered usability, strength, durability, appearance, design, and other characteristics which may be set down as of definite advantage to the buying public. An insurance company recently recopied all of its records because it had used a paper which did not have the necessary durability. The unbreakable doll, the rubber heel, the union suit, and many like conveniences are worthy of a profit.

The Relation of Price and Service

In the question of price rests many conditions both as to the making and the deserving of a profit. The public has many wants—an enormous number if the

whole world be considered. In the main, as to proportion, its income is limited. Its standard of living increases as the relation of its income to its wants increases. Here is a definite goal for service. That industrial unit which, for a given fair quality, markets its goods to the consumer at the lowest price, will certainly get the largest share of the business and would seem to deserve the greatest profit.

Low price is frequently brought about in some degree, however, because some industrial unit puts out a part of its product at cost as a leader, to get a volume of business to reduce the overhead on the rest of its products, or even, as happened successfully with the Ford Company, to force a maximum volume at which a profit can be made. Or occasionally it happens that this is done in a dull period to keep a force busy or to help absorb a fixed overhead. In many such cases it is of doubtful value and even harmful because of retaliation, but where the act is a carefully calculated one based on the facts of a survey, and the results accrue as planned, it may be said to be of definite value both to the public and to industry.

The public is interested in the main, and industry goes forward in the main, only when prices are permanent and not unsettled. The necessity therefore in the matter of prices is that they should operate as the outcome of a definite knowledge of costs, through a cost system, and not as a matter of speculation. It would seem, therefore, that it is the industrial executive who operates intelligently from the basis of a cost system who deserves a profit.

It is very well recognized that human affairs progress most favorably from planning, preparation, detailed preconsideration, and a constant following up to see that each partaker in the operation follows the plan. Scientific management has developed in industry definite principles and methods of planning, routing, instruction, standards, storeroom and toolroom methods, and incentives. They bring economy, increased production, and orderly flow. It would hardly seem that the industrial executive who fails to grasp and apply these methods, is entitled to a profit.

Efficient Equipment a Necessity

It is a fact known to all executives that machinery and equipment and processes are constantly being improved, especially as to their hourly output and labor-saving ability, thus permitting production at lower cost and lower prices. Every practical man knows that only the newly built plant can have for the moment all the up-to-date equipment on every operation, but every industrial executive can, for the seeking, have ample knowledge of the latest machinery, and by careful planning and expenditure can keep his unit reasonably well up to date. That unit which finds itself with old equipment, eventually finds itself behind the times and without a profit, and, it would seem, deservedly so.

The eventual per cent of labor in the cost of the finished article from the raw material to the delivered goods is said to be at least 80 per cent. It is a matter of human nature and experience that all human labor operates more efficiently and, when fairly dealt with, more happily under a proper incentive plan. Here then lies a large opportunity for price improvement, and that industrial executive who, by study and plan, operates successfully to lower cost by incentive methods may be said to deserve a profit.

In short, it is in the desired quantity, best quality and lowest price of service that the buying public is interested. Industry, in its offered service, sets itself theoretically before the public, through its industrial units, to render these best values. Only those units which offer their service based on a study and constant attempt to render that service operated with the most effective equipment, best standard materials, a standard quality, a constant improvement through management, forward-looking personnel methods, and marketing through effective and economical methods, may be said really to deserve an effective profit.

Place of the Management Engineer

It is very often true, however, that industrial executives through lack of training, experience, study, or experiment are unable to employ modern profit-making methods, or to employ them in the best manner. Happily, however, there has grown up and developed in the last quarter of a century a profession of experts in the industrial field. These industrial and management engineers have the advantage of varied experience, observation of many methods in successful industrial units, intimate study of their field, and when possessed of common sense, practical viewpoint and aptitude for the work, they render in their engagements extremely valuable service.

That industry is precarious may be judged by statistics. The Internal Revenue Bureau Report indicates that in 1922, on the whole not a bad business year, some 82,485 manufacturing plants reported their net income situation. Of these, 33,788, or about 40 per cent, reported no net income and averaged $25,000 loss each. The remaining 60 per cent showed an average profit of about $70,000 each. The average net profit of all after federal taxes were adjusted was 5.65 per cent on total receipts, certainly not very great. The profits in 11 main divisions varied from 1.73 to 8.35 per cent, also certainly not great.

This same year showed, according to the survey of current business of the Department of Commerce, some 5676 failures of industrial units with liabilities of $214,920,000. Certainly these figures indicate the great necessity that the industrial executive generally consider more carefully than he seems to do, what he must do to deserve and make a profit.

When you further consider the facts that, of 382,000 corporations (not all of them manufacturing concerns, although the census report of 1919 shows 288,376 industrial units), 170,000, or about 45 per cent, reported no net income, and of the remaining 212,000, those making under $50,000 profit for 1922 were 95,000, and under $2000 were 92,000, leaving but some 17,000 showing $50,000 and over, and only 825 showing $1,000,000, industry impresses one as a magnificent whole made up of a vast number of units, by far the larger portion of which operate with very little success. Does this larger

proportion operate in a manner to deserve no profit?

What profit should an industry make? In view of the fact that in most cases not merely an investment is involved but, in large part, the personal efforts of the owner of capital, that business has risks and complications, that losses must be recouped, that every industrial unit gives many workers the chance to render their share of the world's service and enjoy their reasonable standard of living, it would seem that 10 per cent on total invested capital, after deducting taxes and depreciation, is not too great. The per cent of profit on sales price would vary according to the relation of total sales and total investment.

Factors Affecting Profit

Since industrial units in overwhelming proportion earn no such amounts, it must be put down either to the ruthlessness of competition, or to the fact that so very many industrial executives operate without those intimate understandings of knowledge and control of their unit in operation through manufacturing management so as neither to know how to make, nor to deserve such a profit. Of course there are, as indicated in the statistics, a number of industrial units, small in proportion to the total, which do make a fine profit. May it not be fair to consider that as a whole they operate in the interests of service to the public, deserve a profit, and set an example for the rest of industry?

The ordinary conception of waste in industry revolves ordinarily around material. There is a great opportunity of saving here. The loss in spoiled work alone in one large plant with the reputation of being well run amounted to one-fifth of its profit in 1924. But there is even greater waste-saving to be made in the study of material improvement and substitution.

Every Day Disservice and Loss

There is undoubtedly a large waste in the multiplication of styles and designs. Practically every trade is suffering in this respect, as records of the Department of Commerce will show. In 24 lines reduction has been made from 9525 to 2391 items, varying in per cents from 30 to 97½.

There is a large waste in the use of obsolete machinery and equipment which may gradually be replaced with producing and labor-saving units.

Better credit methods, better safety and fire and protection methods, would save an immense amount of money.

Better production methods, from planning to delivery, are possible everywhere, as is constantly being shown and developed. Better methods of handling the problem of labor costs, from the general one of personnel to the particular one of incentives, are possible in all industrial units.

Better distribution methods, whereby goods are displayed and delivered with minimum addition to factory costs, are undoubtedly needed.

In all these directions any variation from the best possible practice, seldom of course completely obtainable, are wastes, and these wastes are, both in the aggregate and in the industrial unit, of vast proportions.

But, after all, industry is a human institution. It has no other reason for existence than as a service to the human race—the public. A great part of that public, however, is interested in the conduct and success of industry, not merely as a consuming part, but as a producing part, and if industry is to be of service to that great producing portion, it must consider the producers. A great and increasing number of millions of our people spend the larger part of their waking life in industrial service. The industrial units are mainly, to them, service centers. They cast in their abilities and co-operation toward the making of a profit. Need it be said that, from the public point of view, the making of a profit will be considered even more deserved for those industrial executives and industrial units which recognize this service point of view in practical personnel methods, in health- and happiness-making plans, in fairness and friendliness of their human relations methods?

Industry and Universal Well-Being

There are those who consider industry as a threatening institution because of its materialism, and it cannot well be denied that in the past there have been industrial units where the narrow idea of profit alone has brought about conditions of which the law and public sentiment have been compelled gradually to bring about a correction. But there are three points of view possible, greater among all others which make industry constantly more desirable. The first is that a fairly distributed materialism creates greater human comfort, happiness, and morality. The second is that industry is being operated constantly, both in its internal and its external relations, on a higher ethical basis. The third and most hopeful sign is the slowly spreading wider stockholding in industrial units by those personally involved in the work of the unit. Materialism spread over these lines will be helpful. It will be uplifting.

Our modern civilization has found its material advance, has pinned its hope, has created its development upon industry, and its essential concomitant, commerce. This has brought about the greatest development of civilization that the world has known, for industry is, not only in its constant demand and willingness to reward improvement, the greatest developer of the natural laws and sciences, but, with commerce, it is the greatest creator of individualistic development and freedom. Perhaps its present progress is more rapid and intense than it needs to be for best happiness, but the development of organization may some day relieve this pressure.

For its development, profit is essential. For that profit to be beneficent, it only needs that it be deserved. Industry is a very practical proposition, intensely so. But it can still be practical, and yet improved by idealism.

It is the function of the industrial executive to operate steadily forward to deserve a profit. In this direction lies the fulfilment of an ambition as worthy as effort in any other direction of public service.

Specifications for the Purchase of Office Supplies

By ROBERT SHERRAN

Sales Manager, Independent Mfg. Co.

IN small business enterprises as well as in large ones, considerable money is spent each year on office supplies. In but few instances is all of this money spent wisely. The matter of purchasing paper, clips, folders, and even typewriters and more expensive equipment, is often considered of small importance and acted upon with insufficient information, and money is wasted needlessly. This article will present definite information concerning uses, advantages, and disadvantages of various supply items to enable the person who buys such material to make the best use of the money at his disposal. No business is so small that careful purchasing based on accurate information will not be profitable.

Account Books

Books already ruled to meet most requirements can be secured and are much cheaper than specially ruled books. Particularly for ledgers, loose-leaf books are often desirable.

Specially ruled or printed books can be obtained through commercial stationers. If a loose-leaf form is desired, the leaf size should be chosen to fit one of the regular-sized binders. Ruling must be definitely decided upon before the order is placed, as proofs cannot be shown. A good grade ledger paper should be used, and the question of using tinted paper, such as buff, which is easier on the eyes than white, should be considered.

In determining the stock size of paper to be used, allowance must be made for trimming on three sides, with a suitable margin for binding. Color of ink for rulings and width of rules must be decided.[1]

Book Bindings

A *full bound* book is entirely covered with the selected material over 3-ply binder boards, with hubs at the back of heavy books. *Three quarter bound* books have different material on sides from that used for back and corners. In *half bound* books, back and corners are less extensive than in three quarter bound, boards are thinner, and sides are usually of cloth. For books of 500 pages or less, the half bound style affords ample protection, or the book can be fully covered with canvas without hubs at the back. This style is usually called *full canvas half bound.* A full canvas bound book is the most durable binding.

In addition there are *quarter bound* with paper sides, turned-in edges, and a thin strip of cloth or leather at the back, and *quarter bound cut flush* in which the edges of the book are not turned in but are trimmed at the same cutting as the leaves.

Locks may be attached to any book to prevent its being opened by unauthorized persons.

Letterheads

Paper of 20 lb. substance—weight of 500 sheet ream of 17 by 22 in. paper—is usual, but lighter or heavier weights are available. Papers less than 16 lb. substance are charged at 16 lb. rate; others are priced in proportion to weight. Thin paper does not stand up so well under hard usage as heavier grades and does not present as good appearance after handling.

Tinted papers can be used to attract attention but they are more expensive than white. A high finish is not desirable usually and is necessary only when an extra fine photo-engraving is to be used on the letterhead. A dull finish on heavy paper is excellent and high-grade bond paper in any weight will always be satisfactory.

If illustrations or other art work are to be used they should be arranged for early. Designs are usually made large and reduced photographically, using the retouched photograph for making a plate.

Various types of printed headings are available. *Engraving* and *embossing* give the most pleasing results but are also the most costly. These are made from steel or copper plates or dies and raise the letters above the surface of the paper. When several thousand impressions are to be taken, steel plates or steel-faced copper plates should be used. Steel plates should be used with colored inks. Cost of embossing depends upon size of die—minimum price is obtained with a die not more than 1½ by 3 in. Cost of copper plate depends upon style, design and number of letters; steel plates are about 50 per cent higher. An embossed letterhead should cost from $3 to $10 more per 1000 than the same stock printed. This does not include cost of engraving. Sometimes it will be found cheaper to use two small dies instead of one large one.

Lithography provides very attractive letterheads at reasonable cost when large quantities are used, making long runs possible. A design, prepared usually by a commercial artist, is engraved on a stone from which transfers are made to a zinc plate. This process gives more presentable results than type printing, and if 5000 or more headings can be made at a time the price is not much more.

[1] See Section 8, *Management's Handbook*, Ronald Press Co., for additional information on design and paper for forms.

When working from a good layout, an efficient printer can turn out satisfactory letterheads by *ordinary printing* methods. The printer should be consulted before this work is undertaken, as he can often suggest improvements. Various colored inks can be used, with black the most popular.

Plateless engraving is obtained by sprinkling a powder on type-printed paper while the ink is wet and fusing it in an oven. This presents a raised surface similar to engraving, but unless the work is very carefully done the lettering has a tendency to chip off. This method costs only a little more than printing from type and much less than engraving or embossing.

Seldom should more than a year's supply of paper be ordered at a time. Quantities obtained from units of one ream of 17 by 22 in. sheets can usually be obtained cheaper since the printer must pay extra for fractions of a ream. For a small firm 2000 might be a satisfactory quantity—1000 would cost about 65 per cent of 2000 and 500 about 65 per cent of 1000.

Envelopes

The regular business-sized envelope which takes an 8½ by 11 in. sheet folded three times is known as No. 6¾; the official size to accommodate a twice-folded sheet is No. 10. Usually envelopes are made from the same grade paper as the letterheads but it is sometimes advisable to use cheaper stock which seals better.

The Post Office Department can furnish stamped envelopes with printed return address cheaper than most printers can supply them, but the wording and style of printing are limited. Their use provides a check on postage, however, and saves time in affixing stamps. If window envelopes are used, considerable care must be used in typing and folding enclosures. If tinted paper is to be used for both envelopes and letterheads they should be ordered together, otherwise exact matching of colors is problematical.

Ruled headings for *bill-heads* and *statements* are to be had in several sizes. Sometimes bills are bound and perforated in books. Others bill on a typewriter and the duplicate goes in a binder. Typewriter billing offers many advantages: very often additional copies are made for other purposes, such as shipping order, and packing slip. The price is often not desirable on the extra copies and by arranging formation of the printing with date line indented to left, and the use of narrow width carbons, the prices are eliminated on the extra copies. Printers may secure paper for printing, with the back thinly carbonized, which saves time in inserting carbon sheets.

Labels are frequently made in rolls, but the finer class is printed or lithographed flat and cut out with special dies. These dies are similar to those used for envelopes and will cut from 50 to 500 at a time. The die cutter usually has a large assortment of stock dies for circles, ovals and other designs, so before deciding upon the size of a die-cut card or label, ascertain the available dies in stock.

The highly finished labels are varnished after printing, for a dull-coated paper prints better. Labels are frequently made on paper already tinted on top side only, in which you have a choice of about 40 different shades. The standard size sheet is 20 x 25 in. For large orders and for box making these papers may be obtained in rolls.

Typewriters

There are several makes of typewriters which will usually be satisfactory. Although the opinions of typists should not be relied upon too much, it is well to standardize on a make with which most typists are familiar. This will facilitate filling vacancies in the stenographic department.

Consideration should be given to the purchase of rebuilt machines, as they are considerably less expensive than new ones but often give excellent service. The advice of a local typewriter expert should be obtained before buying used machines.

It is not necessary to buy ribbons from the manufacturer of the typewriter, as all reputable ribbon makers furnish proper-sized spools and proper width ribbon. The ribbon fabric should last as long as the ink, but holes may be caused by incorrect feed or incorrect adjustment of the keys. Standard ribbon fabric contains about 280 threads to the square inch with no open spaces. Finer weaves produce neater letters. The edging should be so gummed that threads do not unravel. Different degrees of inking can be supplied. For small type the ribbon should be lightly inked to prevent closed letters filling up. Two color record ribbons should not run together, but when a copying ribbon in two colors is used the dividing line will be blurred.

The government test for ribbons requires a sentence of 30 letters to be written 25 times, reeling the ribbon back by hand at the end of each line. The last line of the 25 must be distinct and easy to read. After letting the ribbon stand for one hour another line is written which must be as clear as the third line of the 25. After half of the writing has been exposed to direct sunlight for 96 hr. there should be no appreciable fading compared with the other portion, previously covered with black paper. For colored inks time of exposure is 48 hr. Ribbons $\frac{9}{16}$ in. or less wide should be 12 yd. long except for some portable machines.

Carbon Paper

There is considerable uncertainty in the minds of typists and stationery buyers over carbon paper. Personal prejudices cause much of this confusion, however, and, of course, should have no influence on the final decision.

Carbon papers can be supplied in various colors, black being the most popular, with blue next.

Standard weight is 7 lb., based on a ream of uncoated paper 20 x 30 in. *Billing carbon* is heavier and excellent for single copy work on typewriters having heavy strokes. *Lightweight* paper is 5 lb. and will produce more legible copies than standard-weight paper. *Featherweight* carbon, of 4 lb. stock, will produce from 8 to 20 copies. *Pencil carbon* paper is made in 7, 10 and 15 lb. weights.

Clearness, intensity of color, and lasting quality should be considered. Carbon characters should be clear, of intense color, and should not smear when carbon paper is removed.

An average of 30 impressions may be expected from a single sheet—the number varying with the care used by the typist. Heavier weight papers do not wrinkle easily and so usually last longer.

Colored foundation paper is sometimes used, but it has no advantage over white. Good stock should be used to avoid small holes through which the carbon mixture penetrates. High polish is no indication of quality.

Filing Systems

There are five basic filing methods: Alphabetical, numerical, subject, geographical and chronological.

TABLE 1. SIZES AND SUBSTANCE WEIGHTS OF PAPER FOR INDEX CARDS

Stock Sizes	Desirable Weights
3x5 in.*	72 lb.
4x6 in.*	72 lb.
5x8 in.*	91 lb.
6x9 in.	91 lb.
8x10 in.	91 lb.
9½x11¾ in.	111 lb.
9½x14¾ in.	111 lb.
11⅞x11⅞ in.	111 lb.

* Most popular sizes.

In the most popular type, *alphabetical,* an index is used, subdivided in proportion to the size of the file. A drawer of an ordinary correspondence filing cabinet will hold about 150 folders. About 20 subdivisions should be allowed per drawer, so, if the expected extent of the file is 4 drawers, an 80 subdivision index should be used.

Numerical systems permit unlimited expansion and usually include a separate alphabetical index for cross-indexing purposes. *Subject, geographical,* and *chronological* systems are usually required for special purposes and the systems are designed to meet individual requirements.

Table 1 gives stock sizes and desirable paper weights for *index cards* based on a ream of 20½ by 24¾ in. paper.

Records to be used or preserved for a number of years should be put on cards made from high-grade rag stock. All cards should be cut by rotary knives, as the guillotine method of cutting does not make uniform sizes and leaves the edges fuzzy. A considerable range of colors is available.

Folders tabbed in two, three, or five positions are more suitable than single tabbed. The two tab is preferred for straight alphabetical systems, the three tab for subdivided alphabetical systems, and the five tab is almost essential for numerical filing. Makers of filing equipment usually have arrangements by which varying quantities of correspondence from a single source are handled effectively.

Folders are made from manila paper, jute, or pressboard. For ordinary requirements, fairly heavy manila is suitable, but where great strength or endurance is needed jute or pressboard should be used. Stock should be heavy enough so that a single folder will stand in the file with little sag.

Guide cards for active card files should be of heavy weight Bristol, with or without celluloid tabs and for inactive or transfer files heavy manila is suitable. Pressboard is suitable for letter files.

Office Accessories

Notwithstanding the prevalence of fountain pens, *steel pens* are still used extensively in offices. Pens of composition metal or plated with nickel or silver withstand corrosion better than plain steel. For long life pens should be wiped after use. A chamois wiper is best, but a damp sponge or shot-filled dish is more frequently used.

Ordinary *writing ink* should be free from sediment. For black ink a week's exposure to sunlight and subsequent immersion in water should not greatly affect its legibility. Large users of ink can economize by buying ink powders to be mixed with water as required.

Inkstands that keep ink fresh and clean are desirable items and can be procured at little cost. *Blotters* should be of 120 lb. stock (based on ream 19 by 24 in.). White is the best color for hand use. A blotter is tested by its absorbency and by noting the amount of residue left after burning a piece. Cheaper grades are loaded with clay and woodpulp and leave more ash.

Marking material used in ordinary *lead pencils* is a mixture of graphite and clay—the hardness being determined by the proportion of clay. Seventeen degrees of hardness are available, but commercial pencils are made in not over five grades. A 2B drawing pencil is equivalent to a No. 1 commercial pencil, HB to No. 2, F is the same in both types, 2H is No. 3, and 4H is No. 4. Quality of writing material varies considerably, the outside finish being a good criterion.

Colored leads in 24 shades are available, red, blue, and green being the most popular. Indelible pencils are made in purple, red, and green.

Rubber bands are used in place of string to bind small packages, papers, etc., and, in addition to being easier to apply and remove they are also cheaper. Bands are sold by weight, so the thinnest and shortest to suit the requirements will be most economical. A good new band will stretch at least six times its length without breaking. Bands should be cut evenly, as they are no stronger than their thinnest part, and useless weight is paid for in uneven bands. A good band will not sink quickly when placed in water. The approximate number of bands per pound for the more popular sizes are: No. 14—3200, No. 16—2500, No. 31—1200, No. 64—425, No. 82—300.

Wrapping paper is sold by weight, which should not include outside wrapping and core of rolls. A high-grade thin paper is often more economical than poor-grade heavy paper. In wrapping heavy packages two thicknesses is sometimes necessary and savings can be made by providing cheaper paper for the inside layer, which may also be smaller than that used for the outside.

Packages that are small and light may be secured with rubber bands or gummed tape, but for bulky and heavy bundles *cord* or *twine* is necessary. Twine is sold by weight and true economy means the purchase of lots of uniform size.

Pins are used for temporary paper fasteners, The usual office size is No. 5, sold in half-pound boxes or pyramids for desk use. T-shaped heads are convenient but more expensive.

By using *clips* to fasten papers together, the papers are not perforated, but often several files are caught together, causing confusion. For permanent fasteners there are several types of *stapling* and *eyeletting* machines. Stapling is quicker and eyeletting makes a more secure fastening.

Rubber stamps cost a fixed price for the first line with extra lines at slightly reduced rates. Fractions of an inch in length are charged at next highest even inch, i.e., 2¼ in. line costs same as one 3 in. long. Designs and borders are extra. Ink used for rubber stamps is a mixture of pure glycerine and aniline dye with the addition of a few drops of phenol to increase penetrating quality. If glycerine used is impure, the ink may crystallize on top of the pad. Quick drying ink has alcohol or ether added.

Office Machinery

Many useful devices are available for offices, but the decision to purchase any one should be based on the needs of the office and the economies possible by using mechanical equipment.

A *postage stamp affixer* is desirable in many offices. Stamps are kept under lock and key, number used is registered, more positive adhesion to envelope is obtained, and an ordinary operator can stamp 50 pieces per min.—10 times faster than by hand.

When a numeric filing system is used or for use in numbering checks, etc., a *numbering machine* is convenient. It should not be exposed to dust, and only finest grade oil and special ink should be used with it.

Adding machines are necessities in offices where considerable computation is done. Various kinds are available, such as electric or hand operated, and listing or non-listing. Individual requirements determine final selection. Listing machines use paper in rolls. News, book, bond, and carbonized paper can be obtained.

For *duplicating machines* using clay or gelatine duplicators, the master copy can be made with copying pencil, special ink, hectograph carbon paper or typewriter ribbon. Number of copies obtainable varies with operator and material used. Ink or ribbon will produce more copies than pencil or carbon paper. For less than 50 copies carbon is often used in preference to ink, as it does not fill up the type. The limit with ribbon or ink is about 100 copies.

When more copies are desired *stencils* may be used from which several thousand copies can be made. Wax, Dermatype, and dry flexible stencils are used. A special ink with a glycerine base is used, as ordinary ink leaves an oily outline around each character. A porous paper is desirable, but, with proper ink, good copies can be made on bond paper.

Machines for producing better work than is possible by duplicators can be obtained. Small automatic presses to print small forms in one or two colors may be purchased for less than $1000. In making such a purchase, privacy and speed are usually the main considerations rather than economy.

Because of fluctuations caused by changing conditions, it is impossible to give exact prices. As a basis for making rough estimates on cost of work ordered by office buyers, appended is an approximate price list, Table 2. This list is based on average prices prevailing in New York City and vicinity during February 1925.

TABLE 2. AVERAGE LABOR COSTS—NEW YORK CITY

Prices include *labor costs only*, material cost is extra.

Cutting paper:	
4 or less from sheet	$0.35 per ream
5 to 12 from sheet	0.40 " "
Cutting cards by hand (not larger than 4 by 6 in.):	
Plain stock, less than 180 lb. substance	0.50 per 1000
Printed stock	0.75 " "
Punching—round holes (slotted holes cost more):	
Light stock Bristol	0.50 per 1000 holes
Heavy stock Bristol	0.75 " " "
Pressboard	1.25 " " "
Paper	0.20 " " "
Eyeletting:	
Large eyelet	4.00 per 1000
Small eyelet	2.50 " "
Tabbing:	
Lightweight cards	1.50 per 1000
Heavyweight cards	2.00 " "
Thumb notching:	
Lightweight cards	1.00 per 1000
Heavyweight cards	1.25 " "
Perforating—12 in. or less:	
Paper	1.00 per 1000
Cards	2.00 " "
Die cutting (price reduction on large runs):	
Paper	0.65 per 1000
Cards—lightweight	0.85 " "
Cards—heavyweight	1.25 " "
Numbering—consecutive:	0.50 per 1000
Folders	1.50 " "
Printing from type (black ink, colored inks cost more):	
Envelopes—Less than lots of 3000	1.75 per 1000
5000 lots	1.50 " "
10,000 lots	1.00 " "
Letterheads—6 lines printing—first 1000, $2.50, add.	1.50 " "
Large heads —first 1000, $3.00, add.	1.50 " "
Announcements—	
50 words or less —first 1000, $2.75, add.	
Each additional line—first 1000, $0.60, add.	
Business cards—First 1000, $2.75, add.	
Plateless engraving:	
Business cards, letterheads, envelopes—1000 lots	6.25
5000 lots	18.00
Announcements, invitations, not over 50 words— 500 lots	6.50
1000 lots	9.00
2000 lots	15.00
Copper and steel engraving:	
Shaded letters	0.27–0.36 per let'r
Solid letters	0.15–0.24 " "
Business cards (on copper) center lines	1.65 per line
corner lines	1.05 " "
Minimum price for engraving	1.50
Copperplate printing:	
Business cards	$1.65–$1.95 per 100
Extras—Cards larger than plate	0.30 " "
Omitting items	0.25 " "
Colored ink, $0.90 first 100, add	0.60 " "
Hand embossing:	
Die not larger than 1 by 2½ in.— 500 lots	$4.95
1000 lots	6.60

COST PER 1000 OF LARGE DIES

Die Size—in.	1000 Lots	2000 Lots	5000 Lots	10,000 Lots
1½x3	$ 6.60	$ 5.85	$ 4.95	$4.65
1½x4	7.65	6.75	5.60	5.40
1½x6	10.05	8.55	7.65	7.20
1½x8	12.90	10.95	9.90	8.25
2x3	7.35	6.30	5.25	4.95
2x4	7.65	6.75	5.70	5.40
2x5	9.00	7.65	6.75	6.45
2x8	12.90	10.95	9.90	8.25
3x3	8.10	7.50	6.60	6.30
3x5	10.20	8.85	7.95	7.80
3x8	13.65	11.70	10.65	9.30
4x4	8.85	8.10	7.05	6.75
4x8	14.40	12.45	11.40	9.75

Note: These are principal sizes. Intermediate sizes cost proportionately, cost being based on increments of ½ in. in either dimension.

Costs In 44 Employees' Lunchrooms

Data Which Prove Industrial Cafeterias to Be Worth-While Investments

By RUSSELL J. WALDO

PERSONAL visits by the writer, on a recent business trip, to employees' cafeterias in 44 manufacturing plants resulted in the gathering of some very unusual data on the financial aspects and importance to industry of providing comforts and conveniences for workers during the lunch hour. The concerns visited were located in New York, Pennsylvania, Michigan and the Central States, and employed a total of 87,636 men and women, of whom 30,372 ate in the cafeterias. Those not availing themselves of the opportunity either lived near the plant and went home during the noon hour or, for personal reasons, preferred to carry their lunch.

The average number of employees in the plants visited was 1992, and the average number of employees using the cafeterias in each was 688, or over 34 per cent. This ratio is a direct indication of the fact that cafeterias are appreciated by the employees, especially since over half of the concerns were located in smaller communities, where a majority of the workers could go home to lunch, while the patrons of the lunchrooms were largely those who were rooming away from home.

The firms visited had equipment totaling in value $297,088, or an average for the 44 concerns of $6752. The total number of cafeteria employees was 704, with a total cafeteria wage of $4664 per week. The average weekly wage for cooks was found to be $34 25. Helpers in the kitchen, including porters for the dining room, received $19.40. Kitchen crews were full-time workers in all but six cases, where the hours of service were from 7 to noon.

Cashiers averaged $4.25 weekly, for in the majority of cases they were employed in the office during the remaining hours, and worked in the lunchroom merely to earn a little extra money. Amount given represents the value of their time spent in the cafeteria. At least $5 was paid for a cashier from the outside, and in one case $10 was paid.

The same condition applies to those serving. The company employees who worked in the cafeteria received an average of $3.30 weekly, while the lowest rate paid for an outside employee for this period of time was $5 and the highest $7.50. Bus girls and boys in the cafeteria were paid an average of $2.55 each week for this work. In all but six instances they were employees of the concern. Outside employees in this class of service received a minimum of $6 weekly.

The total upkeep per week for broken dishes, repairs to equipment, and such charges, was $1282.60, or an average of $29.15 per plant. Several restaurant owners in the larger commercial centers state that this figure is very reasonable, considering the fact that dishes were in most cases washed in tanks by hand and by employees not spending their full time in such work.

The total weekly receipts for the 44 lunchrooms were $72,611. This figure includes factory forenoon lunches bought in the shop, although the number of employees fed daily, stated above, does not include those who bought these forenoon lunches, and neither are they included in the figures given in the individual instances below. The average weekly receipts were therefore $1650.25. The total operating cost per week was $62,748.40, with an average of $1426.10. The balance left the companies each week totaled $9862.60, which averages $224.15. The average price per meal varied from the forenoon lunch, costing $0.15, to a regular noon meal, at $0.55.

Based on the averaged opinions of executives in these plants, the lunchrooms have increased production approximately 6.25 per cent. This, however, is believed to be a very conservative figure.

These average figures from 44 plants will serve as a basis of comparison for the 8 individual cases which

FIG. 1 UNITED STATES SHIPPING BOARD CAFETERIA AT PORTSMOUTH SHIPYARDS, ATLANTIC HEIGHTS, NEW HAMPSHIRE

follow. The 8 cafeterias about which data are given below have been selected because of the ample room and the attractiveness characterizing them, and because they vary in size, receipts and operating costs. Other installations are pictured in Figs. 1 to 4, and two good typical layouts are reproduced in Figs. 5 and 6.

For the individual cases following, floor area has been apportioned between dining room, counter and kitchen. In each case there is included space occupied by passages, aisles, racks, water coolers, checkers' and cashiers' booths, etc. Space for each diner includes half the distance between tables and half of the width of the table.

Cost of equipment has been apportioned among total plant employees. Receipts include money actually spent in the lunchroom, exclusive of that for forenoon lunches. Receipts, operating costs and wages are computed for the week preceding the writer's visit, and include food, wages, and upkeep, but not depreciation. Average price per meal is the average receipts from the average number eating. Full-time cafeteria workers were given 3 meals per day free, if they cared to prepare them, while part-time workers received one free.

Only two lists of equipment have been given, as there is little variation between plants. Actual names of the 8 firms have been purposely omitted to avoid any appearance of philanthropy.

The first concern, an automobile plant (Case No. 1), has operated its cafeteria for three years and one month. It employs 2700 workers, of whom an average of 1200 eat daily in the lunchroom. The lunch period is from 11.30 to 1, and the dining room seats approximately 300 at one time. The equipment is the best obtainable, and has a value of $14,630, or $5.42 per employee.

The dining room is located in the same section of the building as the kitchen, all occupying a space 50 by 105 ft., with a total area of 5250 sq. ft. This space is divided as follows: Seven square feet over an area of 50 by 76 ft. is allowed for each worker, or a total of 3800 sq. ft. The serving counter occupies a space 7 ft. wide and extending the entire width of the building. The kitchen is at the rear and is 50 by 22 ft. in size. There are 5 aisles 3 ft. wide running the entire length of the dining room.

Full-time cafeteria employees are: Six in the kitchen, one in the dining room. Part-time workers are: One checker, one cashier, 8 serving and 5 bus girls. All part-time workers are from the outside. The cook's wage is $40 per week, and the total wages for the cafeteria are $182.50. The cafeteria serves dinner 5 days per week.

The average price per meal is $0.34. The total receipts for the week in question were $2040, and the total operating cost was $1911.60, leaving a balance of $128.40. The upkeep cost for each week is $21.60. The average increase in production throughout the plant, according to estimate, was 6 per cent.

The general manager states: "We find that the introduction of the employees' cafeteria into our plant has not only brought us more and better work from our workers, but they seem happier. We have less labor turnover, our employees staying longer. By all means feed employees, even if it is done at a loss."

The second concern, located in Detroit (Case No. 2), is likewise an automobile plant. The cafeteria has been in operation for nearly 2 years. The pay-roll shows 3800 regular employees, of whom 990 use the cafeteria. These workers eat between the hours of 11.45 and 1

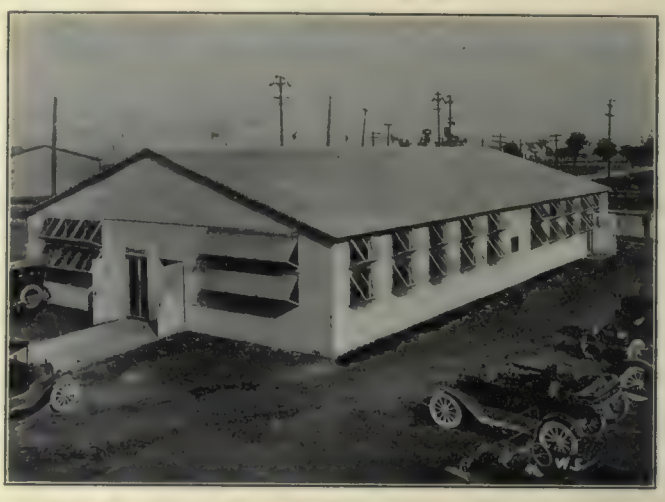

FIG. 2 DINING HALL OF BUICK MOTOR CAR COMPANY

o'clock, the room being sufficiently large to seat 260 comfortably at one time.

The equipment, which cost approximately $11,240, or $2.96 per employee, is as follows: A white enameled service counter 36 ft. long, steam table, ice cream cabinet, 3-piece coffee urn, urn stand, two 2-oven gas ranges, cook's table, saucepan rack, bain-marie, electric vegetable peeler, vegetable sink, butcher's block, refrigerator, electric dish-washing machine, one clean and one soiled dish table, checker's stand, guard rail, water

FIG. 3 DINING ROOM OF GREAT LAKES ENGINEERING WORKS

fountain, twenty-six 4-ft. tables and twenty-six 6-ft. tables, 260 bent-wood chairs, chinaware, silverware, glassware, complete assortment of cook's tools, cooking utensils, baker's work table, bake oven, cake mixer, and sink.

The space occupied by the cafeteria and kitchen is 44 by 96 ft., or a total area of 4224 sq. ft. Each worker

is provided with 7 sq. ft. of space in a portion of the room 44 by 70 ft. The serving counter is 6 ft. wide, including the passage back of it. The kitchen is in the rear of the room and is 20 ft. wide. There are 4 aisles 4 ft. wide and 70 ft. long.

The cook receives $35 per week and has 4 helpers. He serves a meal at a club at night, thereby increasing his earnings. Full-time workers are: Five in the kitchen, one in the dining room. Part-time workers are: One cashier from the office force, and 6 serving women and 4 bus women from the outside. The total wages paid for cafeteria workers per week are $139.25.

The average price per meal is $0.41. The receipts for the week under consideration were $2029.50, with operating costs of $1811.20. This plant serves lunches during the forenoon but the receipts and numbers are not included in any figures shown. The balance for the week was $218.30. The upkeep cost per week is $27.10. The estimate of increase in production due to serving lunch in the plant was conservatively placed at 7 per cent.

The works manager says: "We find that good increases in production have resulted from our lunchroom. Much of this is due to the lunch served during the forenoon. Nearly every week the management serves dessert, free of cost to the workers, from the surplus receipts, and we find that our workers appreciate this to the limit. The cafeteria has brought us better co-operation than any other form of employee service which we could have inaugurated. If we break even we feel that we have made money. We are planning on serving a banquet to our workers at intervals, when an outside speaker will be obtained, the families will be invited, and we will make them all feel really a part of the organization."

FIG. 4 ONE OF THREE LARGE DINING ROOMS OF THE NATIONAL CASH REGISTER COMPANY

A cafeteria in one of the Chicago clothing manufacturing plants (Case No. 3), has been in operation 32 months. Out of a total of 1100 employees, an average of 600 eat in the cafeteria, which seats 150 at one time. The lunch period is from 11.30 to 1 o'clock.

The entire space occupied is 50 by 72 ft. Each diner is provided with 7 sq. ft. of space, the dining room occupying an area of 50 by 44½ ft., or 2225 sq. ft. The serving counter runs the width of the room and is 7½ ft. wide. The kitchen is back of the serving counter and is 20 ft. wide. There are aisles 4 ft. wide the whole length of the dining room.

The total cost was $6890, or $6.27 per employee. Full-time workers are: Kitchen 4, dining room one. Part-time workers are from the office: One cashier, 6 servers, and 3 bus girls.

The cook in this instance is a woman, and she receives $36 per week. She has an assistant receiving $25 per week. The total wages for the week of investigation were $131.75, and 5 dinners were served.

The average price per meal was $0.21. The total receipts were $630 while the operating expenses were $635.40. In this case there was an actual loss of $4.60 for the week, although the writer was shown by actual inspection of the books that there had been in every week preceding a balance of about $10. The upkeep cost was $9.11. The chief of the timekeeping division said that production had increased approximately 9 per cent since the opening of the lunchroom, and there was much less work sent back to employees for reworking.

The vice-president of this concern stated: "We did not start our lunchroom to make money on it. Our workers are in many instances from homes where little attention is given to the proper food. We started the cafeteria to make sure that the worker had at least one properly balanced meal each working day. The results have been more than we expected. Our workers look and feel much better, a fact readily observed by anyone who passes through the plant."

In one of the Chicago meat packing plants (Case No. 4), a cafeteria has been in operation one year and seven months, and out of a total of 1340 employees, 984 eat their meals in the cafeteria. The lunchroom seats 164 at one time. The lunch period is from 11 to 1 o'clock.

The equipment was built in the company's own shops and cost $6450, or $4.82 per employee. The entire space occupied is 32 by 80 ft., or a total of 2560 sq. ft. Each diner is allotted 6½ sq. ft. in an area 32 by 56 ft. The serving counter is across the end, and occupies, with walkway back of it, a width of 6 ft. The kitchen is back of this counter, and is 18 ft. wide. There are 3 aisles 3 by 56 ft. There are only 4 full-time workers and they are in the kitchen. The kitchen porter cleans the dining room. Part-time workers are: One cashier from the office, 6 serving women and 4 bus women from the outside.

In this instance the cook receives only $35 for 6 days. The total pay-roll for the cafeteria is $100.40 weekly.

The average price per meal is $0.31. The week's receipts for the period concerned were $1830.24 and the total operating cost was $1809.17, leaving a balance of $21.07. The upkeep cost per week is $62.80. The estimated amount of increased production is 6 per cent.

The general superintendent states: "Before we opened our lunchroom there was a gradual slowing down in the afternoon. This was eliminated by the

opening of the lunchroom. It is now also possible for the worker to obtain a bottle of milk, a ham sandwich, or a piece of pie during the forenoon, by informing his timekeeper. This privilege has eliminated the slowing down so common in the forenoon in the best of plants, due to workers getting up late and not having an appetite for breakfast. We have quite an upkeep cost due to broken dishes, yet the cafeteria is well worth every cent we find necessary to put into it. We feel better over it and so do our workers."

A cafeteria in a drug manufacturing concern, the fifth case under consideration, was opened in 1921. This company has 930 employees, of whom 420 eat in the cafeteria, which seats 140 at one time. The lunch period is from 11.45 to 1 o'clock. The dining room facilities are housed in a room 27 by 90 ft., with a total area of 2430 sq. ft. Each worker is allowed approximately 6½ sq. ft., the dining room proper occupying a space 27 by 66 ft. The serving space is 5½ ft. wide and the kitchen 18 ft. wide. There are 3 aisles 66 ft. long. The cost of equipment per employee was $4.45, total $4140.

The full-time employees are: Three for the kitchen, one for the dining room. Part-time workers: One cashier, 5 servers, and 3 bus women, all from the outside. The cook, a woman, receives $32.50 per week. The total cafeteria pay-roll is $101.50.

The average price per meal is $0.28. For the week in question receipts were $705.60, with $702.20 operating expenses. This left a balance of $3.40 for the week, which was unusually small. Upkeep cost $9.60 weekly. The improvement in production is estimated at 4 per cent.

The statement of the president of the company follows: "One of the most important results of our lunchroom is the fact that the workers spend less time watching the clock in the afternoon. It is true that there is a lull in the forenoon, and your suggestion as to the forenoon lunch, practiced by many, will surely be tried out with a hope that we may obtain equally good results. The outstanding factor which we note is a closer attention of our employees to their work, which means more production by more contented workers."

FIG. 5 FLOOR PLAN OF THE HENRY DISSTON & SONS CAFETERIA—CAPACITY, 760 WORKERS

KEY TO DRAWING

1 Terrace
2 Private Entrance
3 Private Dining Room
4 Corridor
5 Private Cafeteria
6 Serving Counter
7 Engine Room
8 Toilet
9 Small Refrigerators
10 Refrigerator
11 Butcher Shop
12 Scullery
13 Ranges
14 Steamers
15 Chef's Table and Bain-Marie
16 Bakery
17 Tables
18 China Stores
19 Office
20 Store Room
21 Dishwasher
22 Aisle
23 Main Cafeteria
24 Main Cafeteria Serving Tables
25 Cashier
26 Cigar, Soda, Ice Cream, Candy Counter
27 Reserved Space
28 Entrance
29 Exit
30 Entrance and Exit

A manufacturer of light steel products (Case No. 6), has operated a cafeteria for 28 months. There are 940 employees in the plant, and 276 eat in the cafeteria, which seats 92 at once. The lunch period is from 12 to 1 o'clock.

The equipment, which cost approximately $5000, or $5.43 per employee, includes the following: Steel service counter, steam table, ice cream cabinet, one

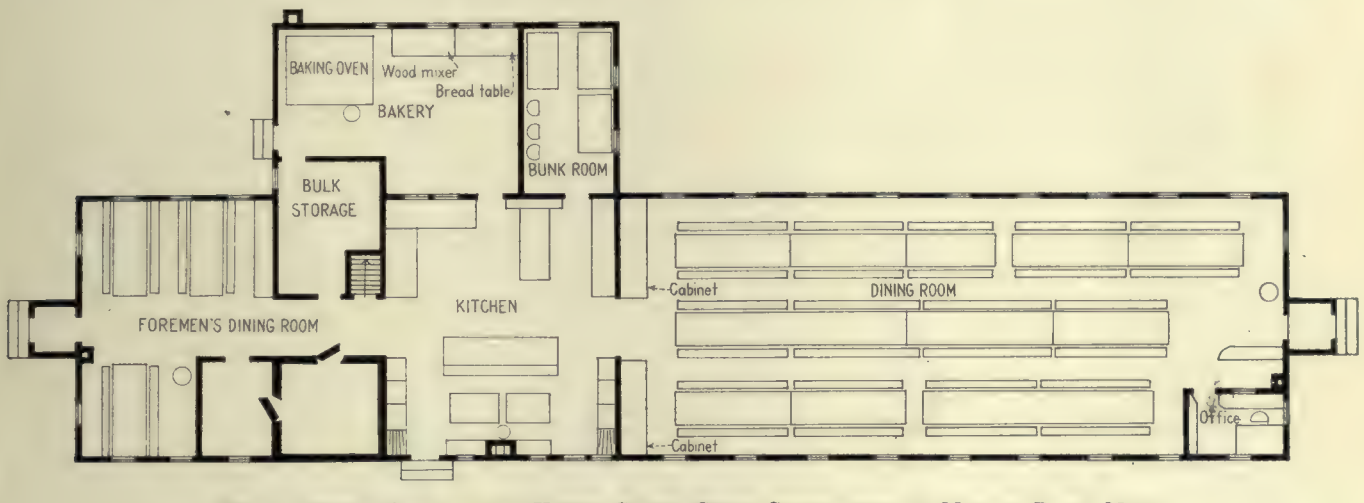

FIG. 6 DINING CAMP OF THE UNITED STATES STEEL CORPORATION AT MORGAN PARK, MINN.

6-gal. coffee urn, urn tray, two 2-oven gas ranges, one 25-gal. steam-jacketed kettle, cook's table, saucepan rack, vegetable sink, bain-marie, butcher's block, refrigerator, dish-washing sink, tables for clean and soiled dishes, guard rail, water cooler, five 4-ft. tables and twelve 6-ft. tables, 92 bent-wood chairs, complete assortment of china, silver, glasses and cooking utensils.

The entire space occupied is 33 by 50 ft., a total area of 1650 sq. ft. To each diner is apportioned 8 sq. ft. in a space 33 by 27 ft. The serving section occupies a space 6 ft. wide and 33 ft. long. The kitchen is 17 ft. wide and 33 ft. long. There is one aisle in the center 4 ft. wide.

The full-time workers are: Three in the kitchen, one in the dining room. Part-time workers: Cashier from the office, and 5 serving women and 2 bus women from the outside. The cook receives $32 for 5 days, which is a good rate for the smaller towns in southern Ohio. The total weekly cafeteria pay-roll is $100.50.

The average price per meal is $0.38. The receipts for the week under investigation for meals were $1835, and, for 2310 forenoon lunches at $0.14 each, $323.40, making total receipts for the week $2158.40. Operating costs were $1978.30, leaving a balance of $180.10. Upkeep cost per week is $17.65. The estimated improvement in production is given as 5 per cent.

Comment in favor of the employees' cafeteria comes from the general manager: "If every concern experiences the benefit which we have realized with our own cafeteria, the makers of this class of equipment will be constantly busy producing it. We had faith in the venture before we entered into it, and our expenditure has proved an investment of the highest order, surely capable of the maximum of returns to our coffers."

In western Pennsylvania is located a rather isolated plant engaged in light metal work (Case No. 7), and employing approximately 1640 workers in normal times. This concern has had an employees' cafeteria in operation for approximately 4 years, at first at its own expense supplying just coffee. Now a regular lunchroom is in operation. It feeds 880 workers every day, 5 days each week and the dining room seats 220 at one time. The lunch period is from 11.30 to 1.30.

The equipment cost $5.87 per employee, or a total of $9630. The dining facilities occupy a space of 4140 sq. ft., 45 by 92 in area. Sufficient space is provided so that every worker may have 8 sq. ft. The dining room occupies 45 by 66 ft. The serving space is 7 sq. ft. wide, the kitchen 45 by 19 ft. There are 4 aisles 4 by 66 ft.

The full-time employees are: Kitchen 5, dining room one. Part-time workers: One cashier, 7 serving girls, and 4 bus girls, all of whom come from the regular office force for the noon hour.

The cook receives $37.50 per week for 5 days. The whole pay-roll amounts to $149. The average price per meal is $0.33. Total receipts for the week under consideration were $1452. The operating costs were $1395.60, leaving a balance of $56.40. The upkeep cost is $14.45 per week. These facilities net an increase in production of approximately 6 per cent.

The general manager cites a few helpful facts: "Our plant, being located somewhat away from every dining convenience, found it necessary at first to supply hot coffee free to our workers. This was such an improvement that soon we added desserts and sandwiches. Later the proposition of a lunchroom was put up to them for vote, and sufficient voted for it to cause us to add it without delay. We are feeding approximately one-half of our workers and find that they appreciate it to the extent that they become better workers."

One of the most successful cafeterias was found in an eastern concern making electrical equipment (Case No. 8), and employing approximately 2400 employees. Among these workers, 540 avail themselves of the service offered by the lunchroom, which seats at one time 180 people. The entire dining department is housed in a large room 40 by 100 ft., 4000 sq. ft. in area. In

one end is a restroom 40 by 25 ft., where employees sit and read. If they choose they may eat lunches carried from home. Some purchase coffee in the lunchroom but these are not included in the figures.

Seven sq. ft. is allowed for each worker, and the dining room itself occupies a space 40 by 31 ft. The serving space is 7 ft. wide and the kitchen, 40 by 22 ft., extends back of the serving section. The cost of the equipment at catalogue list price was $7540. This cost, distributed over the workers, averages $3.15.

Full-time cafeteria employees are: Four in the kitchen, one in the dining room. Part-time workers are: One cashier, 7 serving women and 3 bus women, all from the outside.

In this instance the chef receives $40 per week, the total pay-roll for the week being $146.30. Meals are served 6 days every week.

The average price of each meal is $0.36, making the receipts for the week in question $1182.60. The total operating cost was $1029.42, leaving a balance of $153.18. The upkeep cost per week is $41.40. The value in increased production is estimated at 9 per cent.

The general manager's statement, in part, follows. "The employees' dining room has served two fundamental purposes. First, it has brought our workers closer to us as a family, and second, by doing this it has improved their morale, ambition and diligence. Our surplus from the lunchroom goes into necessary equipment and serving free hot coffee to employees during the forenoon at their work. We believe that the lunchroom is one of the best investments we have made to hold production to a maximum."

Several definite conclusions were reached as a result of this investigation. In the first place, forenoon lunches have proved decidedly beneficial. Some managers claim that 10 minutes given over to eating during the mid-morning results in a 15 per cent increase in production during the last hour before noon. So positive are a few of them on this point that they have indicated a willingness to supply sandwiches and coffee free of charge, just a "bite" to satisfy until noon.

The serving of noon lunches at the plant is usually done not free, but at cost. There is far less loafing before the blowing of the whistle than when each worker shifts for himself. An ample, well-balanced meal is provided and eaten in comfort and leisure, elements tending toward better health of employees. They go back to their work in better spirits and with a higher morale, better fitted to do a good afternoon's work than any other means could make them. Less accidents occur during the afternoon and following the forenoon lunch in plants where meals are provided. Altogether the plan is well worth the time and trouble of installation, it costs nothing after the original outlay for equipment, and it yields better returns in production than any other method or investment.

TABLE 1. SUMMARY OF DATA ON EQUIPMENT AND OPERATION OF EMPLOYEES' LUNCHROOMS

ITEM	TOTAL 44 PLANTS	AVERAGE 44 PLANTS	PLANT 1	PLANT 2	PLANT 3	PLANT 4	PLANT 5	PLANT 6	PLANT 7	PLANT 8
Plant location			Michigan	Detroit	Chicago	Chicago	Illinois	Southern O.	Western Pa.	Eastern U. S.
Nature of product			Automobiles	Automobiles	Clothing	Meat packing	Drugs	Light steel products	Light metal work	Electrical equipment
Plant lunch hour			11.30 to 1	11.45 to 1	11.30 to 1	11 to 1	11.45 to 1	12 to 1	11.30 to 1.30	11.30 to 1
Cafeteria in operation			3 yr. 1 mo.	2 yr.	2 yr. 8 mo.	1 yr. 7 mo.	4 yr.	2 yr. 4 mo.	4 yr.	1 yr. 9 mo.
Employees: Total plant	87,636	1,992	2,700	3,800	1,100	1,340	930	940	1,640	2,400
Patronizing cafeteria	30,372	688	1,200	990	600	984	420	276	880	540
Per cent of patrons to total		34.5%	44.5%	26%	54.5%	73%	45%	29.5%	53.5%	22.5%
Seating capacity, cafeteria			300	260	150	164	140	92	220	180
Cost of equipment: Total	$297,088.00	$6,752.00	$14,630.00	$11,240.00	$6,890.00	$6,450.00	$4,140.00	$5,000.00	$9,630.00	$7,540.00
Per employee		$3.39	$5.42	$2.96	$6.27	$4.82	$4.45	$5.43	$5.87	$3.15
Size: Dining room			50 x 76 ft.	44 x 70 ft.	50 x 44½ ft.	32 x 56 ft.	27 x 66 ft.	33 x 27 ft.	45 x 66 ft.	40 x 31 ft.
Serving table			50 x 7 ft.	44 x 6 ft.	50 x 7½ ft.	32 x 6 ft.	27 x 5½ ft.	33 x 6 ft.	45 x 7 ft.	40 x 7 ft.
Kitchen			50 x 22 ft.	44 x 20 ft.	50 x 20 ft.	32 x 18 ft.	27 x 18 ft.	33 x 17 ft.	45 x 19 ft.	40 x 22 ft.
Total			50 x 105 ft.	44 x 96 ft.	50 x 72 ft.	32 x 80 ft.	27 x 90 ft.	33 x 50 ft.	45 x 92 ft.	[1]40 x 100 ft.
Aisles			Five 3 x 76 ft.	Four 4 x 70 ft.	Four 4 x 44½ ft.	Three 3 x 56 ft.	Three 4 x 66 ft.	One 4 x 27 ft.	Four 4 x 66 ft.	Three 4 x 31 ft.
[2] Space per diner, sq. ft.			7	7	7	6½	6½	8	8	7
Attendants: Full-time			7	6	5	4	4	4	6	5
[3] Part-time—employees			0	1	10	1	0	1	12	0
Part-time—outsiders			15	10	0	10	9	7	0	11
Total	704	16	22	17	15	15	13	12	18	16
Wages: Total, per week	$4,664.00	$106.00	$182.50	$139.25	$131.75	$100.40	$101.50	$100.50	$149.00	$146.30
Cook, per week		$34.25	$40.00	$35.00	$36.00	$35.00	$32.50	$32.00	$37.50	$40.00
Meals: No. per week			5	5	5	5	6	5	5	6
Average price		[4]$.15 to $.55	$0.34	$0.41	$0.21	$0.31	$0.28	$0.38	$0.33	$0.36
Financial operation — receipts, one week	[5]$72,611.00	$1,650.25	$2,040.00	$2,029.50	$630.00	$1,830.24	$705.60	[6]$2,158.40	$1,452.00	$1,182.60
Expenses, one week	62,748.40	1,426.10	1,911.60	1,811.20	635.40	1,809.17	702.20	1,978.30	1,395.60	1,029.42
Balance, one week	$9,862.60	$224.15	$128.40	$218.30	[7]—$4.60	$21.07	$3.40	$180.10	$56.40	$153.18
[8] Upkeep, average per week	$1,282.60	$29.15	$21.60	$27.10	$9.11	$62.80	$9.60	$17.65	$14.45	$41.40
Increase in production—estimated per cent		6.25%	6	7	9	6	4	5	6	9
Other benefits			Contented workers. Less labor turnover	Better co-operation	Better health	Eliminates forenoon and afternoon slowdown	Closer attention to work		Greater contentment	Improved morale

[1] 40 x 25 ft. restroom included, in which employees may eat lunches brought from home.
[2] This includes half of area between tables and half of the distance across the dining table.
[3] Usually the cashier.
[4] Forenoon lunches $0.15. Noonday lunches, maximum $0.55.
[5] Amount of receipts includes forenoon lunches, but number patronizing cafeterias does not. For Plants 1 to 8 forenoon lunches are not included.
[6] $1,835 for 2,310 regular noon lunches in cafeteria, and $323.40 for 2,310 forenoon lunches at $0.14 each.
[7] There is usually a balance of receipts over expenditures amounting to $10 per week.
[8] This is already included in operating expenses, and is separated here for purposes of comparison.

Controlled Production of Knit Goods

Methods Used by Company Producing 5000 Manufacturing Units

By HERBERT C. GATES

Head of Planning Department, The William Carter Company

OUR plant is an underwear manufacturing plant, selling a complete line of men's, ladies', children's, and infants' undergarments direct to the retail trade. Our mills are located in Needham Heights, Framingham, and Springfield, Massachusetts, Reidsville, North Carolina, and Barnesville and Macon, Georgia.

Our selling organization of 60 salesmen operates from branch offices in six principal trade centers of the United States. These offices maintain stocks of merchandise for re-order business within their individual territories. The main portion of finished stocks is kept at Needham Heights, where also are located two of our mills and the main office. The sales manager's office is at Needham Heights, where his advice and recommendations concerning new numbers, sales tendencies, and general trade conditions are an integral part of the broader aspects of our planning department.

The general superintendent directs manufacturing in our six mills. The production manager directs planning and production for all plants and operates mostly through the medium of the planning department.

TABLE 1. TYPICAL WEEKLY PRODUCTION

Mill	Work Units[1]	Product
1	48,000	Men's
2	90,000	Ladies'
3	38,000	Children's
4	56,000	Infants'
5	26,000	Nainsooks
6	84,000	All groups
Total	342,000	.....

[1] A work unit is the amount of finishing labor required to complete a shop order from the first cutting operation to the final finishing process. It is derived from the labor cost of a typical number in each group and is used to show relative amount of labor necessary to complete orders in the various groups.

Our product is of two distinct kinds, knit goods and nainsook garments.

In the knit goods line we manufacture 120 different cloth fabrics, 10 per cent of which are in the natural color, 60 per cent bleached white, 15 per cent tinted cream color, 5 per cent ecru and 10 per cent dyed in colors. These cloth fabrics represent, of course, many different combinations of cotton, worsted, silk, and merino yarns. Each group has its own particular styles in which practically all fabrics are carried. For instance, men's suits are made in regular, short, ¾ length, and athletic style. Ladies' suits are made in 15 different styles, and other groups in like number. Since all numbers must be carried in a range of sizes, we have approximately 5000 manufacturing units.

In the nainsook line, we carry a much smaller number of cloth fabrics. The men's suits are made in two styles, the ladies' suits in three styles, and the children's suits in three styles.

Seventy-five per cent of the total business is done on 25 per cent of the fabrics and the great benefits of specialized production are made possible by the layout of general manufacturing shown in Table 1.

Functions of the Planning Department

1. To determine from sales analysis what kinds of goods will be manufactured and the quantity of same. This also involves the determining of delivery dates for these goods to be made.
2. To give the purchasing department several months' advance notice of material requirements by kind, quantity and date required.
3. To determine the manufacturing schedules for the mills by styles and quantities.
4. To determine if new machinery and equipment are needed and notify the management.
5. To control stocks of all materials.
6. To issue to the mills the weekly and daily work orders by fabric, style and size, and to assign these orders to the proper departments and machines.
7. To check the daily, weekly and monthly production of the different mills and departments against their operating schedules.

Determining What to Manufacture. A constant watch is kept on the records of finished stock, goods in process, goods authorized for manufacture and sales received to date. By comparing current conditions with previous years' sales and by modifying the resulting figures with the advice and recommendations of the sales manager and production manager, a fair degree of accuracy in forecasting sales is effected. Fig. 1 shows the form used for this analysis.

In any business selling direct to the retailer a line of goods which offers variety of fabric and style, someone in the organization must guess what the people are going to want. During the past few years we have seen the retailer change his former policy of ordering a season's requirement in advance, to a hand-to-mouth

policy which automatically forces the manufacturer to carry the stock. It is evident that this method of buying on the part of the retailer emphasizes more than ever the value of preparedness and the almost absolute necessity of it on the part of the manufacturer in making up in advance only those fabrics and styles which are going to sell quickly and readily; otherwise the carrying charges on slow moving goods would overwhelm the business.

The "sales analysis supervisor" issues to the scheduling supervisors sufficient manufacturing orders to keep the mills busy for three or four months. Each scheduling supervisor issues his work orders to his mill on a daily basis, planning ahead two weeks at a time. These balances to manufacture are set up for each fabric, style and size on a card record for each mill and as amounts are issued to the mills they are deducted from the balances. These amounts are known as "balance authorized to manufacture." As these amounts decrease through successive weekly issues to the mills the sales analysis supervisor authorizes further amounts, bearing always in mind sales conditions and trends and holding back or going ahead as sales fluctuations demand. Thus a continuous and diligent check is kept on goods made for stock and a competent hand is ready at all times to put on the brakes or speed things up.

Notice of Requirements to Purchasing Department. Orders issued to the scheduling supervisors cover periods of from three to four months and are translated into material requirement by the "materials supervisor." He breaks down all issues into three main divisions, yarn, trim, and chemical. Trim materials include finishing threads, buttons, facing, binding, shoulder straps, etc., and chemicals consist of bleaching materials, dyes, soaps, oils and acids.

Total requirements are summarized and then reduced to an average weekly basis, this average weekly basis being obtained by dividing the total requirements by the number of weeks' work ahead of the mills. (See Fig. 2.) These weekly requirements are, of course, individualized for each mill, since complete manufacturing processes are carried on in each mill. These requirement charts are turned over to the purchasing

PLANNING RECORD
(Sales Analysis Sheet)
Men's Suits
Date 12/10 1924 Rec'd ... % Balance Est. ... % Min. ... %

	Fabric and Style	16 1	18 2 34	20 3 36	22 4 38	24 5 40	26 6 42	28 7 44	30 8 46	32 9 48	34
Prev. Year's Sales	4435/18			300	200	400	500	600	700	300	
Net Sales to Date				200	180	390	600	660	700	330	
Est. Sales for period				400	400	600	700	800	900	500	
Less available Stock				100	200	100	300	200	300	300	
" " Process				200	100	100	300	200	200	200	
" " Authorized				100	100	100	400	100	100	100	
Total available Stock				400	400	300	1000	500	600	600	
Balance to Manufacture				100	100	450	—	500	500	200	
Prev. Year's Sales											
Net Sales to Date											
Est. Sales for period											

FIG. 1 SALES COMPARISON SHEET

department and adjustments and corrections made to them from time to time as conditions change. The purchasing department is held responsible for specifying material according to these specifications.

Make-Up of Mill Schedules. Manufacturing schedules for the several mills are worked up by the head of the planning department under the direct supervision of the production manager. From the three or four months' work ahead of the mills, a certain time limit is automatically set for the production of the work as a whole. The next step is to determine what individual groups and classes of orders must be pushed ahead more rapidly and what groups or classes should be made up more slowly. These groups are determined chiefly by past experience. Into this consideration must come the best and most profitable utilization of machinery and equipment. A smoothly balanced operating schedule is the goal with sharp rises and declines eliminated. By intelligently planning ahead this is accomplished.

The total number of dozen to be manufactured within the three or four months' period is divided into

STOCK REQUIREMENTS
By System Dept.

Date of Issue 12/24/24 No. 239

Fabric No.	Size	Q'ty	Min. Stock	When Needed	Fabric No.	Size	Q'ty	Min. Stock	When Needed
4735/10	4	10	15	Jan.					
4775/10	6	30	50	Feb.					

FIG. 2 NOTIFICATION OF MATERIAL REQUIREMENTS

equal weekly schedules, and the totals are then broken down into the different manufacturing groups. (See Fig. 3.) This sub-division is based on the fact that certain classes of goods require certain peculiar key finishing operations and we, therefore, have such groups as men's suits, ladies' high neck suits, ladies' tube suits, ladies' silk vests, child's drop seat suits, etc. These figures are checked against a year's sales requirements in order to discover any inconsistencies or unusual conditions. To the making up of the manufacturing schedules the production manager brings his knowledge of how much money can be tied up in goods in process and also how much money is required to carry the finished stock until it moves to the customer.

Determining Need for New Equipment. Each mill's schedule is figured to determine the machinery and equipment required. These requirements are grouped as follows:

1. Winding machines.
2. Knitting machines by cut and head.
3. Bleaching, dyeing and drying equipment.
4. Sewing machines by kind and style.
5. Special machines and special equipment.

These are checked against the machinery and equip-

ment on hand, and the shortages and surpluses marked on a master recapitulation sheet for all mills. Transfers of machines are made from mill to mill when possible and feasible. In cases where new machinery is needed, a purchase requisition is made out by the head of the planning department. It is then O K'ed by the production manager who sends it to the general superintendent for engineering specifications, and it then goes to the management for ordering.

KNITTING ORDER for

Serial No. 46

Mill No. 6 Week of 10/10/24 to 10/17/24 Date 10/1/24

FABRIC	7½	8	8½	9	9½	10	10½	11	12	12½	13	14	15	16	17	18	19	20	21	22	23	24	25	26	GRAND TOTAL
4639	Machine Numbers Cloth Order												2-16 600	3-5 700	7-10 700	8-11 1700	9-12 240	14-17 300	16 300	17 360					4900
4940	Machine Numbers Cloth Order										18-1 400	24-26 500	28-30 600	30-40 700	42-41 700	46-1 700	49-60 800	68-66 400	67-65 400	63-61 400	79-78 400				6000

FIG. 3 MILL SCHEDULE SHEET

Controlling Stocks of Materials. Materials are issued on requisition only. These requisitions are authorized by the foremen of departments and are based on the monthly, weekly and daily work orders issued by the planning department.

Issuing the Work Orders to the Mills. We have a twofold object in the make-up of the work orders: first, to see that the most urgently needed numbers, styles and sizes are issued ahead of stock orders; and secondly, to see that the manufacturing schedules are filled and an average even flow of work maintained throughout all departments.

Data needed in making out the orders for the mills (see Fig. 4) are: first, a complete and detailed set of records listing all machinery and equipment in the mills and specifying the fabrics and sizes which are made on each machine; secondly, a set of records which gives us the standard production rate of all fabrics, styles and sizes on all machines.

The guide in selecting correct manufacturing orders for the mills is what we call a "below minimum report." On all numbers, styles and sizes we set a minimum figure of 25 per cent of the previous year's sales. When stock available—that is, finished stock plus process—falls below this minimum figure, all such quantities are reported on this "below minimum report" by the stock department to the planning department. These reports are sent to the planning department weekly and are used by the scheduling supervisors in selecting the items to make up the mill's weekly work orders. This "below minimum report" is a very important record, and by carefully following this guide we are able to manufacture intelligently ahead of sales requirements. At the beginning of a selling season, however, it is necessary to double this minimum quantity automatically. As the selling progresses and goes beyond the peak, we revert to the original minimum of 25 per cent. Using this "below minimum report" as a guide or advising list, the scheduling supervisor selects from the balance authorized the quantities necessary to make up the mill's weekly cutting orders, and issues a shop order on the mill for their production.

In the event of the below minimum report not providing enough items to complete the cutting schedule, the remaining portion is filled in with stock orders.

These weekly cutting orders are split up into five equal parts for the first five days in the week, and each day's allotment is so marked. (See Fig. 5.) This provides an even flow of work by schedule groups into the seaming departments. It also enables the planning department to check the cloth used for each day's cutting with the standard amount required.

Sheets covering each day's cutting orders are sent to the ticket department which prints the shop orders and sends them to the mills. These shop orders are sent in a small cardboard box with the date plainly marked on the outside. All shop orders on previous cutting dates must be cut before the next day's work orders are started upon. If, because of lack of cloth or poor match of shade, orders cannot be cut, they are reported at once to the scheduling supervisor, who takes the proper steps to correct matters and then authorizes the cutting of the next day's orders.

Each week's orders are assigned a cycle number corresponding to the current week of the year, and all

WEEKLY PRODUCTION ALLOTMENT

Date Issued: 12/10 From 12/19/24 to 12/26 1924 Serial No. 49

Fabric No.	Dozens Wanted	Assortment of Sizes 32	34	36	38	40	42	44	46	48	Remarks
4439	600		100	100	100	100	100	100			A
4638	1000		200	200	200	200	100	100			B
4900	300				100	100	100				C
4800	400			100	100	100	100				D
											Production Dept.

DETAILS OF MATERIALS REQUIRED, ISSUED, CUT, ETC.

Serial No. A	Serial No. B	Serial No. C	Serial No. D
Garment No.	Garment No.	Garment No.	Garment No.
Fabric / Yards	Fabric / Yards	Fabric / Yards	Fabric / Yards
Shipped Yds.	Shipped Yds.	Shipped Yds.	Shipped Yds.
No. Dozens Cut	No. Dozens Cut	No. Dozens Cut	No. Dozens Cut
Yards Cloth Used	Yards Cloth Used	Yards Cloth Used	Yards Cloth Used
Avg. No Yds. per Dz.	Avg. No. Yds. per Dz.	Avg. No. Yds. per Dz.	Avg. No. Yds. per Dz.
No. Yds. Ret'd to Bin	No. Yds. Ret'd to Bin	No. Yds. Ret'd to Bin	No. Yds. Ret'd to Bin
Total Surplus Stock	Total Surplus Stock	Total Surplus Stock	Total Surplus Stock
Remarks:	Remarks:	Remarks:	Remarks:

FIG. 4 MANUFACTURING ORDER

CUTTING ALLOTMENT Serial No. 99

For Mill No. 6 For September 10 1924 Date of Issue 8/16/24

Number	Style	Size	Dozen	Fabric	Estimated Amount of Cloth Required								Remarks
					Bodies		Sleeves		Pieces or B &B		Gussets		
					Head	Pounds	Head	Pounds	Head	Pounds	Head	Pounds	
4439	18	6	40	439	18	200					18	40	
"	18	7	40	"	19	200					18	40	
"	18	8	50	"	19	250					18	40	
"	18	9	60	"	20	300					18	40	
4639	15	5	100	639	17	500					18	100	
"	15	6	250	"	18	1200					18	250	
"	15	7	300	"	19	1500					18	300	
"	15	8	200	"	20	1000					18	200	
"	15	9	200	"	21	1000					18	200	

FIG. 5 CUTTING ORDER

operations must be done upon oldest cycles first.

The stock records department is given a copy of the cutting sheets so that they can enter the amount of material used on their process records.

SIZE OF HEADS

Mill No. 6 Date 10/20/24

CLOTH NO.	7½	8	8½	9	9½	10	10½	11	12	12½	13	14	15	16	17	18	19	20	21	22	23	24	26	GRAND TOTAL
4435													100	250	350	200	400	50						1350
4639								200	400	300	300	400		600	660									2860
4884															400	500	400	400	500					2200

FIG. 6 MATERIALS USED REPORT

Cloth and trim materials for each day's cutting are figured as the items are selected and these requirements for each day's work are deducted from the respective stock records.

Knitting orders are made out on a weekly basis and the order is given by fabric, head and amount, with a notation as to the machine it is assigned to. The knitting orders are made up on a strictly machine-hour basis and are designed to cover two main points: first, the cloth which is short for actual cutting orders already issued to the mill, and secondly, to cover our normal predetermined weekly knitting schedule. These orders are deducted from the blanket order of the planning department and copies are given to the yarn department to provide another check on yarn stocks against the next week's requirements. The knitting work tickets are printed up by the ticket department and forwarded to the several mills in the same manner as the cutting tickets.

The knitting orders for cuffs and tubing, and the cutting orders for stay are handled in exactly the same manner as the cloth knitting and cutting orders.

Mills are kept supplied at all times with two weeks' orders for all departments.

Check-Up of Production. Detailed records of all stocks on hand, received, and used, are maintained by the planning department, and the mills report daily of all materials made, used, and transferred. (See Fig. 6.)

In the case of the cutting orders, the materials used are carefully compared with the standard allotments, which are actual test weights. Excessive amounts used are reported to the cost department, which computes the cost of the excess, and forwards the result to the general superintendent and production manager. These reports are sent weekly and continued excesses are reported to the management.

In the case of the knitting orders, control boards for all mills are maintained in the planning department with all orders listed and assigned to machines. These orders are assigned on a machine-hour basis and machines which fall behind in production are easily noticed by the congestion of blue pins which represent rolls of cloth behind schedule.

Monthly stocks of all materials are compared with each month's standard stocks, and excessive inventories appear on the charts in red area. (See Fig. 7.) The figures for the standard stocks are computed on the basis of current amounts used, thus assuring fair and equitable standards.

Detailed records of the production of all departments of all mills are kept on a daily, weekly and monthly basis, and these quantities compared with the operating schedules.

Detailed records of goods in process are maintained for all departments by schedule groups and danger points set for excessive and deficient amounts of process.

Quality 4435

Head 14					15					16					17				
Date	Rec'd	CLOTH Sched.	CLOTH Used	Balance of Stock	Date	Rec'd	CLOTH Sched.	CLOTH Used	Balance of Stock	Date	Rec'd	CLOTH Sched.	CLOTH Used	Balance of Stock	Date	Rec'd	CLOTH Sched.	CLOTH Used	Balance of Stock
				600					400					700					850
12/6	400			1000	12/6	300			700	12/6	200			900	12/6	400			1250
12/10		100		900	12/10		100		600	12/10		200		700	12/10		300		850

FIG. 7 STOCK RECORD SHEET

As is very often the case when a well-planned system of production control is installed and operated efficiently, the benefits realized from its use have exceeded the most optimistic expectations, and have practically eliminated back orders.

Classification of Causes for Variations From Standard Labor Costs

Symbols and Method of Use on Time Cards

By M. R. LOTT

Sperry Gyroscope Company

IT often happens in the best regulated factories that workmen fail to turn out work within the time allowance set for the job. With no definite information concerning the reason for failure, the obvious reaction by the management, and especially by the cost department, is to blame the workman. Although it is sometimes proper to do so, more often the reason for delay will be found in conditions over which the workman has no control. In such cases criticism, either direct or implied, is sure to anger the workman, give him the belief that the management is unjust, and, by lowering his morale, decrease his productivity. Also, unless true reasons for labor cost variations are discovered, the variations continue and no effective campaign can be undertaken to lessen their occurrences.

These conditions have been recognized in the Sperry Gyroscope Company and, at the suggestion of I. H. Mills, the factory superintendent, the causes for various differences between actual and allowed times have been analyzed and symbols which can be placed on the labor cost cards provided for the usual causes. That is, if a man has difficulty in performing the machining operation due to hard castings, he places the symbol 1 on the time card in the space provided; should a defective tool be supplied he would use the symbol 22, etc. A full list of symbols and causes for which they stand is shown in Table 1.

The principal advantages that apply to the scheme are:

1. It permits the person engaged in the manufacturing processes to point out the causes for variations in standard labor costs.
2. It permits summaries to be made of the variations in time by causes, and points the way to the correction of unnecessary wastes.
3. It permits a better relationship between the worker and the management by accounting for excessive time consumed in turning out a piece of work, and places the blame in the proper place.

The details of the plan will be more clearly understood if a synopsis is given of the general process of planning for manufacture followed by the Sperry Gyroscope Company. The fact that only a few parts of a kind go through the manufacturing processes at any one time, makes the problem of scheduling production and planning the method for doing the work unusually difficult; nevertheless the plans followed have yielded a very satisfactory control over the production.

When orders are released for manufacturing by the sales division, the production control department secures the required manufacturing information in the form of design specifications, blue-prints and such other written instructions as may be required. This information is analyzed, the material requirements cared for, and the manufacturing program outlined. The drawings for new parts that are apt to be used in connection with future orders are sent to the methods department, which supplies the manufacturing aids and instructions that are not given by the apparatus engineers but are required by the men doing the work. These aids include the design and supply of such special tools and fixtures as the probable manufacturing quantities justify. Instructions are issued in the form of operation sheets, which give the sequence of operation, the tools to be used, and the allowed time for each step, distinguishing the set-up time from the actual manufacturing processes.

Due to the fact that the work is not of a repetitive nature, the workmen are not paid according to a piecework or premium plan, but receive a fixed rate per hour established for each individual within the schedule limits for his trade and based upon a rating plan which compares his abilities with others in the same occupation. Nevertheless it has been found desirable to have definite times specified for each operation as a goal to strive for. They are established first as estimated times and checked by actual performances. The estimated times are based upon well-recognized standards for cutting speeds at different depths for the various materials together with suitable allowances for handling time, etc.

How do these estimated times work out in actual practice? The symbol plan was devised to supply this information and other facts of interest bearing upon actual manufacturing performances.

It is the practice, when issuing a job to a workman, to supply him with a cost time card upon which the time spent in doing the work is to be recorded. When this card is received by the workman, it bears the time allowance. It is customary for the workman, methods man, and foreman to check the actual performance against the estimated time whenever new work is being undertaken, and make necessary alterations in the allowed time so that a reasonable standard time will be established for future guidance. If a workman experiences difficulty in consistently following the standard time thereafter, he usually calls the foreman's attention to the situation. A proper explana-

tion for the variation is made by placing the symbol of the cause on the time card.

The actual time is also compared with the allowed standard time before the cost cards are forwarded to the factory cost department and when variations of 10 per cent or more are discovered the reason is determined and properly noted with a symbol. The cost department maintains a record of the amount of time entered against these various causes and prepares a weekly summary for the use of the factory executives.

The first ten months' records showed that 67 per cent of the total variations from standard time were overruns, while 33 per cent were below the estimate. The following summary groups the reasons for deviation:

1. Of the hours of labor by which the actual time of performance exceeded the standard time:
   - 23.5% was due to conditions of materials worked with.
   - 22.5% was due to conditions affecting the tools.
   - 6.9% was due to the machines used.
   - 2.4% was due to wrong or lack of information.
   - 23.5% was due to the time allowance.
   - 13.2% was due to fault of workman.
   - 0.3% was due to inspection.
   - 7.7% was due to time spent in developing better ways for doing the work.
2. Of the hours of labor by which the actual time of performance was less than the allowed time, practically all was due to liberal allowance in the original estimates, though some time was saved by being able to use part of the machine set ups utilized on other jobs.

The skill of the worker is recognized as one of the contributing causes for deviations from the standard time allowed. While the methods man indicates by symbol on the operation sheet the type of man that he believes to be best adapted to the work, it is not always possible for a foreman to assign jobs to men in strict accordance with their abilities. This is particularly true when there is a variety of work to be done in small quantities, there being occasions when a highly skilled workman is given a simple operation to perform, either because the work has to be done and no lesser skilled men are available, or because it may be better to keep a high-grade man employed steadily than to send him home. Should conditions necessitate using a different grade of workman than that specified on the operation sheet, the fact is explained by placing on the cost time card the symbol indicating the grade of worker used.

It has been considered that there are three main groups of workers in each occupation, known as highly skilled, skilled, and semi-skilled, with a fourth class including helpers and apprentices.

The causes for variations as listed in Table 1 were compiled by the foremen. At the very beginning, these men were called together by the factory superintendent, who outlined the general scheme and asked them to analyze conditions, selecting from their experiences the usual causes for any appreciable deviation of actual performing time from the estimated time allowance provided on the operation sheet.

So, having had a part in the preparation of the plan, they were exceptionally keen to follow up the analysis of jobs going through their departments, when the scheme was placed in practice. The subject has come up for discussion many times during their group meetings in the foreman's council, and new symbols are added at their suggestion if there is a real need for them. One of the later items was symbol 35, which stands for "Fault of supervision." In their spirit of fairness, they have felt that at times they themselves interfere with the workmen in different ways, and consequently pile up cost on the job, so they wished to have some means of taking their share in the responsibility.

While the plan of using estimated times was observed for several years before the scheme of symbols was adapted, the benefits which are to be derived from standard times were not so fully enjoyed as when the analysis for causes of deviation were better known. It has fully demonstrated its value to the company and to the men who have occasion to use it.

TABLE 1. SYMBOLS USED

Cause for deviation from standard time

Symbol	
	Materials
1	Defective castings—very hard.
2	Defective castings—blow holes.
3	Defective castings—excess stock.
4	Forgings—very hard.
5	Forgings—blow holes.
6	Forgings excess stock.
7	Defective castings due to pattern.
10	Required material not available.
11	Required material other than specified on blue-print.
12	Defective material supplied.
13	Required material available but wrong material supplied.
14	Material injured by distorting or defacing.
15	Material characteristics: varying degrees of hardness; quality of material; varying degrees of straightness, flatness and smoothness.
	Tools
20	Tools not available before job required by production department.
21	Tools not available at tool crib.
22	Defective tools supplied.
23	Tool broke down in operation.
	Machines
25	Proper machine not available, in use for another job.
26	Defective machine or equipment discovered defective after setting up.
27	Defective machine or equipment, broke down during operation.
	Information
30	Operation sheet not available, mislaid or carried away.
31	Operation sheet not available, made by methods department but not supplied by production department.
32	Blue-print mislaid or carried away.
33	Wrong information.
34	Insufficient information.
35	Fault of supervision.
	Time Allowance
36	Insufficient time allowed.
37	Time consumed less than time estimated.
38	Additional set-up, original order broken into smaller lot.
39	Machine set-up on previous lot.
	Workman at Fault
40	Operator not accustomed to this class of work.
41	Operator unable to meet time, due to physical condition.
42	Operator did not make an honest effort.
43	Inexperienced operator.
44	Previous operation at fault.
	Inspection
46	Waiting for inspection.
47	Defective inspection on previous operation
	Development
51	Experimenting with factory methods.

Better Shipping Containers

Features of Excellence in Design—Faults in Construction

By FLOYD T. SMITH

Industrial Department, General Electric Company

CONTAINERS in some form are generally necessary to move material satisfactorily, the form of container varying, of course, with the type of commodity, kind of handling to be encountered, volume, and distance to be moved.[1] The type of container has much to do with the economical and efficient handling of material.

The many thousands of manufacturers throughout the country require many types of containers, not only for the distribution of finished products but for moving raw materials. The transfer of material is usually made under two classifications—package freight and bulk or free-flowing freight.

Practically every form of package freight can be

FIG. 1 TYPICAL PIER SCENE, BUSH TERMINAL

shipped by express. The express companies, however, observe certain size and weight limits. For fiberboard or pulpwood boxes built and strengthened in accordance with standard specifications, the weight of the box and contents must not exceed 90 lb. and the outside dimensions must not exceed 90 in. If the box is furnished with a wooden frame, the weight limit is 200 lb. For the ordinary crated fiber or pulpboard box, the maximum outside dimensions must not exceed 110 in. and the maximum weight is 70 lb. Packages of glassware and other fragile articles must not exceed 65 lb. The general regulations covering express shipments are clearly defined in the Official Express Classification No. 27 and I. C. C. No. 1500.

The size limit for a parcel post package for domestic mail is 84 in. in combined length and girth. The limit of weight of fourth-class matter is 70 lb. for parcels mailed for delivery within the first, second and third zones, and 50 lb. for all other zones. The 50 lb. limit applies to parcels for Manila, Philippine Islands, but parcels for other places in those islands may not exceed 20 lb. The allowable dimensions of the parcel post package for foreign mail are a greatest length of 3½ ft. and a greatest length and girth combined of 6 ft. However, for Argentine the round package must not exceed 19 in. in diameter, and long cylindrical packages must not exceed 8 in. in diameter and 4 ft. 11 in. in length. For China, the size limit is 84 in. in length and girth combined. The weight limit for most foreign countries is 11 lb., but for some countries is 22 lb. Regulations controlling both foreign and domestic parcel post shipments are explained in the U. S. Official Postal Guide.

Purpose and Use of Containers

The container is used for holding numerous small articles, a single article or bulk material, either solid or liquid, to facilitate shipment. It also serves as protection against careless handling and blows. The strength necessary is usually in direct proportion to the weight of the quantity shipped, and generally any container that will carry the weight will offer the required protection. By protection is meant protection against damage from without, and not against breakage in case of fragile articles, as this should be afforded by interior packing.

With no additional freight charges, a strong case making 100 trips would be much cheaper than 100 cases making one trip each. Pine shooks are a big

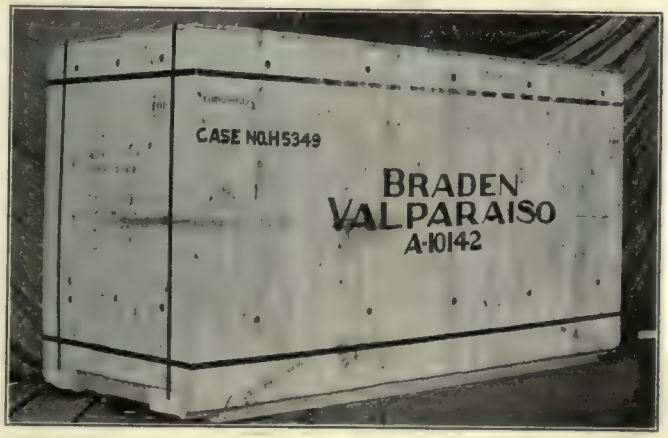

FIG. 2 PACKING FOR EXPORT SHIPMENT

[1] See *Management's Handbook*, Section 20, Ronald Press Co., for additional information and tables.

economy, and save freight, since they can be shipped knocked-down and are easily and cheaply put together with nailing machines. The inherent problem of containers, so far as manufacture is concerned, is in the difficulty of adjusting the cost to the price of the article contained. The customer dislikes to pay extra for a container, but in some instances the cost may of necessity become part of the selling price of the commodity, and the attractiveness of the container is often an effective selling argument.

FIG. 3 X-RAY TUBE BOXING

The tendency at the present time is toward larger and heavier freight cars and weak containers. The principal reasons for the use of weaker containers may be the high cost of lumber and the gradually increasing use of fiber cases. Poorly constructed and weak containers necessitate the packing and storing of heavy articles at the bottom. This causes loss in time and extra cost in labor. All fragile articles cannot be piled high and this results in light top loading, making additional freight cars necessary. Freight cars are usually loaded to 35 per cent capacity, and in the shipment of L. C. L. freight there is often not enough freight at the platform to make up a car for the station to which the car is routed.

Many advantages result from the use of a uniform size and type of container. Careful consideration should be given to the "space factor," which is the percentage of space in a freight car, ship's hold, terminal, or warehouse, that is actually occupied by a commodity after deducting the packages and spaces between them. Measurement of various types of packages reveals a great difference in degrees of efficiency in the use of space. Wrappings, boxing, spaces, etc., often account for more room than the interiors of the packages, the ratio being affected by size, shape and strength of the containers. Freight rates and warehouse rentals are largely based on space occupied.

The marine ton is not a measure of weight, but usually 40 cu. ft. of space. The more goods that can be put into that space, the lower will be the rate per pound. Warehouse space is rented with a maximum loading limit, and the nearer this limit is approached, the less the storage charge per pound.

When material is shipped in carloads a minimum weight is set, on which freight must be paid, no matter how light the load may be. Unless the load equals this minimum the result is excess freight being paid on the shipment. For instance, if a car of 36,000 lb. minimum rating is loaded with charcoal in barrels, it will hold approximately 20,000 lb., leaving 16,000 lb. paid for but not used. If shipped in bags, the full 36,000 lb. could be stowed in the car and the lowest rate would prevail.

A uniform size and type of container permits the use of available space with maximum load at lowest rate; makes handling easier and faster; and makes possible the development of new labor-saving apparatus which can be used universally.

FIG. 4 DOMESTIC PACKING, OUTER CONTAINER OF 3-PLY VENEER BATTEN

FIG. 5 DOMESTIC PACKING, RADIOLA IV COMPLETELY PACKED FOR SHIPMENT

Packing

Packing as applied to shipping may be defined as putting up goods in the form of a package or container for transportation. The package may be a box, crate, carton, bale, bundle, barrel, drum, sack, bag, etc. Articles in a container would be protected by bracing or packing to fill up open spaces and to prevent movement in the container. Proper packing prevents wastage in transit. The protection of goods from damage is a

most important factor, although the container and wrapping material, aside from the factor of protection, are also indispensable for economical shipment and storage. The requisite considerations may be outlined as follows:

Adequate protection from damage during shipment.
Maximum saving of shipping space.
Weight.
Minimum cost in packing, handling and delivering at ultimate destination.

Cargo space is often saved by using bales instead of boxes, or bags instead of barrels. Good packing not only prevents merchandise from damage during shipment and storage, but is often an advertisement as well.

The estimated economic loss and damage claims of industries and railroads for all classes of domestic and foreign shipments is many million dollars. This, of course, is not all due to faulty containers. There is a further loss which probably cannot even be estimated—that is, the dissatisfaction of customers which results when goods are lost in transit or are received in damaged condition.

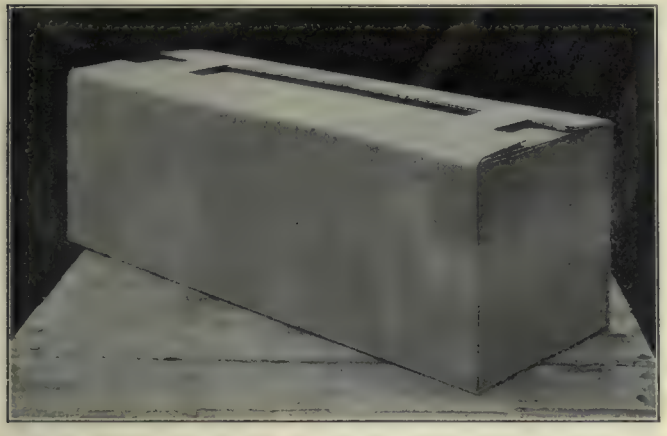

FIG. 6 DOMESTIC PACKING, RADIOLA ENCLOSED IN INNER CONTAINER OF FIBERBOARD

The Interstate Commerce Commission, railroads, and express companies have definite regulations concerning the methods of packing.[2] Commodities not packed in accordance therewith may be refused for shipment or, if accepted, a penalty rate applied. Export shipments are, in addition, subject to the regulations of steamship companies and the regulations of foreign countries of destination.

Tests Made to Determine Container Design

The Forest Products Laboratory is the industrial research branch of the Forest Service of the United States Department of Agriculture at Madison, Wisconsin. It is maintained in co-operation with the University of Wisconsin. The laboratory has co-operated with associations, large manufacturers, forwarding companies, and furniture and box manufacturers in improving the packing of widely varying types of commodities, such as electric lamps, cream separators, automobile parts, small tractors, talking machines, boiler castings, furniture, paints and oils, piano benches, fruit baskets, and crates of shoes. The tests and studies made resulted, in many cases, in the redesigning of the containers. The types of construction adopted give increased strength and often decrease the amount of material used in their manufacture; give more security against pilfering; decrease the cubic contents; reduce the labor and cost of manufacture; make possible more rapid production of packages; decrease the cost of ocean freight; and permit improved methods of handling freight. This work is of value to all manufacturers, shippers and dealers, and to the public at large.

[2] See Express Classification No. 27, I. C. C. No. 1500, and Consolidated Freight Classification No. 4.

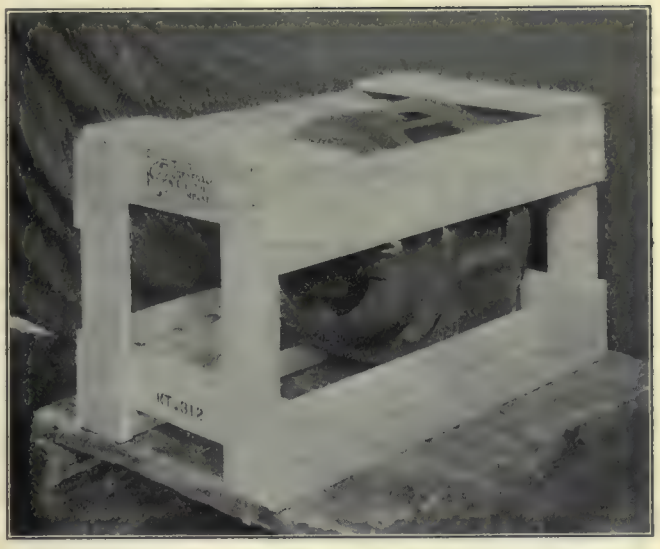

FIG. 7 DOMESTIC PACKING, SHOWING INDUCTION MOTOR PACKED FOR SHIPMENT

Aids in Container Designing

Faulty containers cause losses in many ways. They may have too much lumber in them, resulting in unnecessary cost for material as well as extra freight charges. When the lumber is too thick or when there is unnecessary space within the box, shipping space is wasted. The material of the sides, top, or bottom may be so thin that the shocks of falls pull the wood from the nails. The containers may be insufficiently nailed, permitting the contents to be easily lost or pilfered. The weak feature may be too few nails, nails of too short length, nails driven in a crack and thus having insufficient holding power, or some other form of nail failure.

In fastening bracings, nails or bolts should be used. Lag screws are not recommended, since it is most difficult to draw a lag screw "home" without overdoing it. A single turn or even a part of a turn on the lag screw, after it is properly set, practically destroys its holding power.

Boxes should be properly closed. Poorly assembled or improperly closed boxes are frequently opened by

a slight fall or jolt, exposing the contents to damage and theft.

A properly designed container has enough strength in each part for the purpose for which it is intended, and no more strength in any part than is necessary to balance the average strength in every other part.

No general rules can be laid down, for the reason that each box must be built with reference not only to the external shocks it will have to endure, but also to the nature of the article it is to contain. Some commodities require partitions, internal blocking, trays, diaphrams, etc.; others are affected by heat and cold. Some articles are weatherproof and are shipped on skids without cases; others are of such form as to require cushioning—that is, one box floated inside another with felt or excelsior. Some articles contribute strength to the package; others are fragile; so that all the required strength must be in the box itself.

FIG. 8 DOMESTIC PACKING, SHOWING METHOD OF SECURING INDUCTION MOTOR IN CRATE, ALL BRACING BEARING ON FRAME

It is advisable to adhere as closely as possible to a maximum gross weight of 300 lb. and a maximum measurement of 2 ft. x 2 ft. x 3 ft. It has been found in both domestic and foreign shipments that less difficulties are encountered with this size and weight. Wherever possible, the container should have the shape of a cube. The advantage of this construction is that it permits the case to ride in the position in which it lands, whereas if one dimension is much less than the others, the case will receive more shocks from falling or tipping over while in transit.

Commercial conditions and practice in box factories are taken into consideration in designing containers of proper construction. Packing boxes are generally made of low-grade lumber, in which splits, shapes, knots, knot-holes, decay, dote, or other defects often occur. If defects are found in such quantities as to affect the best construction of the container, the lumber should be discarded. Lumber with defects which do not destroy the proper balance of the construction should be used, however, so as to keep down the cost of manufacture.[3]

One of the preferred designs of crate construction is the three-way corner construction end. All internal cleats and bracing so far as possible should be so placed that the compression stress is against the grain of the wood. For large containers or cases, the skid is important. A container is only as strong as the skid which forms its backbone.

Certain box factory equipment is standard. This should be kept in mind and no construction adopted that requires special equipment unless some essential features of construction cannot be obtained otherwise.

A design which takes into consideration these points and the conditions in the industries as well will result in the most practical and well-balanced construction. Each commodity should be studied before a container is constructed for it. Packages for foreign service are subjected to more severe hazard than those shipped to domestic markets and should be protected accordingly.

Quality and Condition of Lumber

Studies of dryness, weight, hardness, shock-resisting ability, resistance to nails, tendency to splits, etc., as well as the holding power of the various sizes and kinds of nails, screws and strapping, have made it possible to group the woods generally used in packing boxes into four groups, so that in a general way any wood in one group substituted for any other wood in the same group and built into a box of the same specifications will give practically the same results in commercial service.[4]

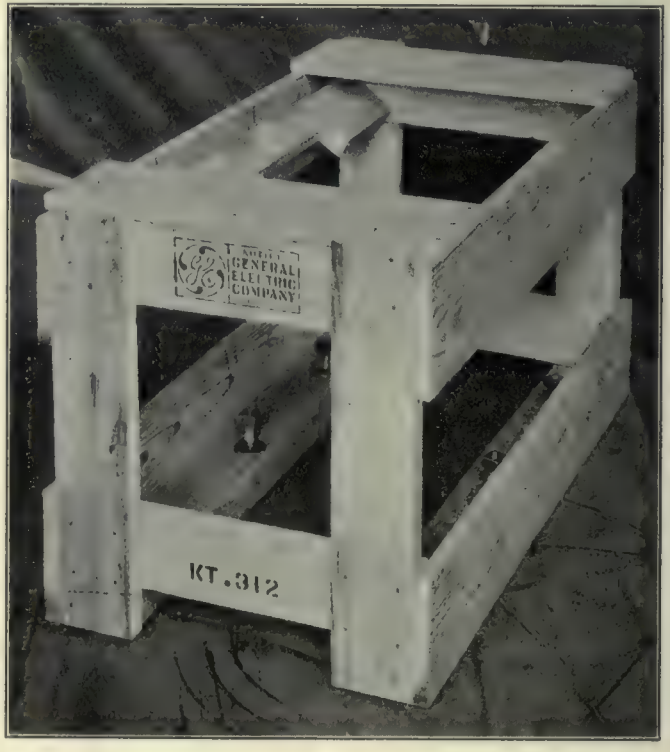

FIG. 9 DOMESTIC PACKING, COMPLETE INDUCTION MOTOR CRATE, SHOWING 3-WAY CORNER CONSTRUCTION

A box should not be made of wet wood. If wet wood is used and the box is shipped to a hot, arid country, the wood shrinks. This leaves large spaces around the nails and the box loses at least a quarter of its strength.

[3] See Supply Circular No. 22, War Department, Purchase, Storage and Traffic Division.

[4] See *Management's Handbook*, pages 1127 and 1129, Ronald Press Co., for tables of woods and sizes.

Method of Finding Minimum-Cost Quantity in Manufacturing

Formulas for Size of Production Lots

By RALPH C. DAVIS

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AN important item in manufacturing costs, which is rarely handled in a rational manner, is the cost of carrying inventories. In the average plant, no effort is made to determine how the different factors which affect this cost vary. It is realized that the relation of the cost of setting up the job to the size of the lot affects the unit cost; that the unit cost may be affected adversely as a result of excessive interest charges if the lot is too large; that whether the lot to be manufactured is or is not too large depends on the rate at which the product will be sold and the rate at which it will be manufactured. However, the balancing of these factors against one another is done empirically,

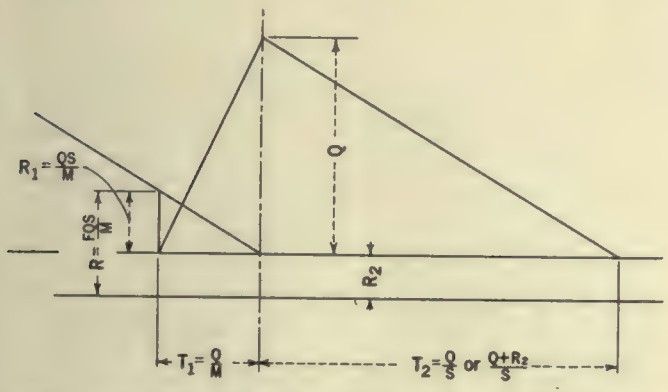

FIG. 1 CURVE SHOWING THE MANUFACTURE AND CONSUMPTION OF THE QUANTITY, Q

or a guess is made by some person in the organization who is considered competent in such matters.

In this article is developed a rational method of determining the proper quantity to manufacture and to carry in stock to give the least unit cost, taking into consideration the effect of the following factors on that unit cost:

A = Total set-up and preparation cost of processing, including the cost of adjusting and dismantling the equipment.
C = Total cost of the quantity to be manufactured.
C' = Unit cost.
D = Direct labor cost per piece.
L = Material cost per piece.
O = Overhead cost per piece.
I = Current rate of interest.
M = Rate at which the quantity will be manufactured, expressed in pieces per year.
P = Unit cost of storing the quantity, Q (below) exclusive of interest charges.
Q = Correct number of pieces to manufacture in order to obtain a minimum unit cost.
R = Minimum ordering point. It is assumed that, when the balance of stores ledger shows that the available supply has fallen to the minimum ordering point, a request for a manufacturing order will be originated and manufacturing will start without undue delay.
R_1 = Theoretical minimum. This is assumed to be a quantity on hand at the beginning of manufacturing, which will be completely exhausted coincident with the completion of manufacturing.
R_2 = Reserve stock. This is the amount of stock which is inactive. Where such a reserve is maintained, it is not withdrawn from stores except in the case of an emergency such as an increase in consumption beyond the estimated rate or unusual delays in manufacturing. The value of R_2 may be either positive or negative. If the old stock is exhausted before the completion of manufacturing and we are using stock from completed lots on the new order, the value is negative. (See Fig. 1.)
S = Rate at which the stock will be consumed, expressed in pieces per year.
T_1 = Time required to manufacture the quantity, expressed in years.
T_2 = Time during which the stock is being exhausted, expressed in years.

Determination of Minimum Ordering Point

The minimum ordering point, expressed in pieces in stock, may be written as a function of the theoretical minimum, R_1.

Let F = A factor which indicates the ratio of the minimum ordering point to the theoretical minimum.

Then $R = FR_1$.

But $R_1 = T_1S$, as it depends on the rate at which the stock is being withdrawn from stores and the time required to manufacture the new lot.

$$\text{And } T_1 = \frac{Q}{M}$$

$$\text{Therefore } R_1 = \frac{QS}{M} \text{ and } R = \frac{FQS}{M}$$

In other words, the minimum ordering point is directly proportional to the quantity to be put into stock, the rate at which this quantity will be consumed, and the amount of reserve stock to be carried. It is inversely proportional to the rate at which the order will be manufactured and put into stores. The probability of delays in the manufacture of the quantity, Q, is considered in the determination of the manufacturing rate, M.

R_2 = The reserve stock, expressed in pieces

$$= R - R_1$$

Substituting

$$= \frac{FQS}{M} - \frac{QS}{M} = \frac{QS}{M}(F - I)$$

The interest charge resulting from the manufacture and storage of the quantity, Q, is one of the most important factors in the determination of the proper quantity to manufacture. In determining this interest charge, we must differentiate between two conditions. The first arises when the minimum ordering point, R, is greater than the theoretical minimum, R_1. In other words, when the factor, F, is greater than 1. The second condition arises when the reserve stock, R_2, is a negative value. In this case, R is less than R_1, and the factor, F, is less than 1. Under such conditions, the old stock would be exhausted before manufacturing would be completed and it would be necessary to withdraw, at the rate S, the new stock coming into stores.

Interest Charge When F Is Less Than 1

Let W = the total quantity in stock on completion of manufacturing.

Then $W = Q + R_2$

$$= Q\left[\frac{M + S(F - I)}{M}\right]$$

The addition in the above equation is algebraic.

Let W' = The quantity on which interest is charged.

$$= \frac{(Q + R_2)}{2} = Q\left[\frac{M + S(F - I)}{2M}\right]$$

In this case, R_2 is negative. Therefore, the quantity on which interest is charged is something less than $\frac{Q}{2}$, as indicated above.

$$T_1 = \frac{Q}{M}$$

$T_2 = \frac{W'}{S}$ for this case.

Then I_1 = Interest charges during time of manufacture

$$= W' \times C' \times I \times T_1$$

And I_2 = Interest charges during time of consumption

$$= W' \times C' \times I \times T_2$$

Let I' = Total interest charges

$$= I_1 + I_2$$

$$= W'C'I(T_1 + T_2)$$

$$= Q\left[\frac{M + S(F - I)}{2M}\right] \times \left[\frac{Q}{M} + \frac{Q}{S}\left(M + \frac{S[F - I]}{M}\right)\right] C'I$$

$$= Q^2\left[\frac{M + S(F - I)}{2M}\right]\left(\frac{M + SF}{MS}\right) C'I$$

$$= Q^2\left[\frac{M^2 + MS(2F - I) + S^2F(F - I)}{2M^2S}\right] C'I$$

Let K_1 = A constant

$$= \left[\frac{M_2 + MS(2F - I) + S^2F(F - I)}{2M^2S}\right] C'I$$

Then $I' = K_1Q^2$

Interest Charge When F Is Greater Than 1

In this case, we have a reserve stock on which interest must be charged during the whole time of production and consumption of the quantity Q.

As in the previous instance, let

W' = Quantity on which interest is charged

$$= \frac{Q}{2} + R_2$$

$$= Q\left[\frac{M + 2S(F - I)}{2M}\right]$$

$T_1 = \frac{Q}{M}$ as before, but in this instance

$T_2 = \frac{Q}{S}$ because by our definition, R_2 is a reserve which is never withdrawn except in an emergency. As previously pointed out, R_2 does not actually exist when F is less than 1.

By an algebraic process, similar to that used in determining the interest charges when F is less than 1, we determine that for this case:

$$I' = Q^2\left[\frac{M^2 + MS(2F - I) + 2S^2(F - I)}{2M^2S}\right] C'I$$

$$K_2 = \left[\frac{M^2 + MS(2F - I) + 2S^2(F - I)}{2M^2S}\right] C'I$$

$$I' = K_2Q^2$$

Determination of the Quantity Q

The equation for the total cost of manufacturing the quantity Q can be written as follows:

$$C = A + I' + DQ + LQ + OQ + PQ$$
$$= A + KQ^2 + (D + L + O + P)Q$$

Therefore, the unit cost is

$$C' = \frac{A}{Q} + KQ + (D + L + O + P)$$

To determine the value of Q which will give the least unit cost, it is necessary to differentiate the above equation with regard to Q, and place the first derivative equal to zero.

Differentiating, we get:

$$\frac{DC'}{DQ} = -\frac{A}{Q^2} + K$$

Placing the first derivative equal to zero:

$$K - \frac{A}{Q^2} = O$$

$$Q^2 = \frac{A}{K}$$

$$Q = \pm\sqrt{\frac{A}{K}}$$

We cannot have a negative value of Q. Therefore, the equation of Q to give the minimum unit cost is:

$$Q = \sqrt{\frac{A}{K}}$$

We find then that the value of the quantity which can be manufactured with the least unit cost depends on:

A = Total set-up and preparation cost of processing. An estimate of this cost can be furnished by the time study section.

M = Rate of manufacturing, expressed in pieces per year. An estimate of this value can be furnished by the planning department.

S = Rate of consumption, expressed in pieces per year. An estimate of the value of this factor can be given by the sales department. It should be made with regard to the effect of seasonal and cyclical changes on the volume of business.

F = Factor which indicates the ratio of the minimum ordering point to the theoretical minimum. This factor can be determined directly by the balance of stores section.

C' = Unit cost of the quantity to be manufactured. In most instances, the unit cost of the last order will be sufficiently accurate for all practical purposes.

I = Current rate of interest. The value of I will be affected to some degree by the trend of the business cycle.

When these values have been determined, the determination of the proper quantity to manufacture becomes a simple problem for the slide rule.

The work is further simplified by the fact that many of these factors, when once determined, need not be determined again until after a considerable length of time has elapsed.

Simplified Equations for K

The equations for K_1 and K_2 are apt to be too cumbersome for the average office employee to solve easily and quickly. Therefore, simplified equations, which can be used without great inaccuracy for most of the cases which would be met in actual practice, have been worked out. These equations, with the corresponding values of F, are:

VALUE OF F	CORRESPONDING EQUATION
0.25	$K = \left(\frac{M - 0.5S}{2MS}\right) C'I$
0.50	$K = \frac{C'I}{2S}$
0.75	$K = \left(\frac{M + 0.5S}{2MS}\right) C'I$
1.00	$K = \left(\frac{M + S}{2MS}\right) C'I$
1.25	$K = \left(\frac{M^2 + 1.5MS + 0.5S^2}{2M^2S}\right) C'I$
1.50	$K = \frac{(M+S)^2}{2M^2S} C'I$
2.00	$K = \left[\frac{(M + S)(M + 2S)}{2M^2S}\right] C'I$

The available manufacturing capacity, storage space, problem of balancing, manufacturing program and other considerations may make it inadvisable to process the exact quantity indicated by the formula. The quantities so determined are those which will give the minimum costs under the conditions considered in the formula. They should be used by the management as an aid in determining the quantities which can be manufactured in a single set-up to the best advantage. The formula can be used to good advantage in connection with the manufacture of any standard product.

Where a large number of quantities are to be computed, the necessary information should be collected on a form designed for this purpose, which should be sent to the department heads having such information. When the computation is made on a slide rule, the time required for each item is less than a minute.

Example of the Use of the Formula $Q = \sqrt{\frac{A}{K}}$

The following example will serve to indicate the use of the formula and the information which must be obtained.

Assume the following conditions:

1. In determining a production program, it has been agreed that a reasonable sales expectation is 5000 units during the coming six months. Furthermore, the position in the cycle for the industry and in the general business cycle is such that it is reasonable to expect to maintain at least this rate of sales throughout the year. Therefore, the annual rate of sales is 10,000 units. The problem is to determine the proper quantity of part number 25 to be manufactured. It happens that two of these parts are required for each assembled unit. For part number 25 then, the rate of sales, S, is 20,000 pieces per year.

2. The production or the planning department advises that the capacity of the plant in relation to the total amount of work scheduled in the production program is such that we can expect to manufacture these parts at the rate of 125,000 pieces per year.

3. Furthermore, the parts will be processed in relatively small lots so that it will be possible to withdraw new stock from stores after approximately 20 per cent of the total quantity has been manufactured. Therefore we assume that the factor $F = 0.25$.

4. Interest at the rate of 6 per cent will be charged on parts carried in stock.

5. The cost department advises that the standard cost for the part, the basis on which business is being taken, is \$10 per piece.

6. The average cost of planning jobs for standard products is estimated at \$0.50 per operation. This includes the work of the drafting room and the work of preparation. As there are 110 operations on the part, the cost of planning and preparation will be \$55.

In the shop are the cost of setting up and adjusting the machines, lost production, increased scrap, unabsorbed overhead, the cost of dismantling the set-up and similar charges. This cost is estimated by the standards section to be about \$5 per operation for the type of work under consideration. The total cost of setting up then is \$550, and total set-up and preparation charge, A, is \$605.

Therefore, the values for the factors which enter into the determination of the quantity to manufacture are:

$$S = 20{,}000 \text{ pieces per year}$$
$$M = 125{,}000 \text{ pieces per year}$$
$$C' = \$10 \text{ per piece}$$
$$F = 0.25$$
$$I = 0.06$$
$$A = \$605$$

$$\text{Then } K = \frac{(M - 0.5S)}{2MS} C'I$$

$$= \frac{(125{,}000 - 10{,}000)}{(2 \times 125{,}000 \times 20{,}000)} \times 10 \times 0.06$$

$$= 0.0000138$$

Solving for the quantity Q:

$$Q = \sqrt{\frac{A}{K}}$$

$$= \sqrt{\frac{605}{0.0000138}}$$

$$= 6{,}621 \text{ pieces}$$

In other words, under the conditions assumed, it will be most economical to manufacture approximately four months' supply with a single set-up. At the estimated rate of manufacture, it will require a little more than two weeks to manufacture the order.

Endless Conveyor to Elevate Bales of Straw

AN endless conveyor at the Antioch plant of The Paraffine Companies, Inc., is shown in the accompanying photograph. It has solved the problem of elevating large bales of straw to the roof of the digester plant.

The bales, weighing 180 lb., are delivered to a long platform which parallels the conveyor. When they are to be elevated, the binding wires are cut and the bales are dropped onto the conveyor, which automatically carries them along to the edge of the platform. Here the conveyor rises, the inclined portion being supported on 3 sets of posts. At the discharge end, the bales of straw are dropped into the digesters where they are cooked for 13 hours. This is the first operation in the pulp-making process.

The conveyor system eliminates absolutely all hand labor, and automatically controls the supply of straw for the digesters to the proper amount at all times.

FIG. 1 ENDLESS CONVEYOR TO ELEVATE BALES OF STRAW

21 Material-Handling Installations Which Have Saved Money

Striking Data on Trucks, Tractors and Cupola Chargers

By GEORGE E. HAGEMANN

Associate Editor, MANAGEMENT AND ADMINISTRATION

MANUFACTURING firms installing material-handling equipment, and then checking up on the comparative costs of doing work with this equipment instead of by hand labor methods, almost invariably find that they have saved unexpectedly large sums of money in their operations. One of the greatest advantages of thus replacing brawn with brain, or the product of an engineering brain, lies in the fact that it is a sound economic policy as well as a release of many men from back-breaking drudgery. The present article adds to the already numberless cases on record of savings brought about in the handling operations of many industries.[1]

TABLE 1. CLARK TRUCTRACTOR DATA

South Side Malleable Casting Company

COST OF OPERATING ONE TRUCTRACTOR	
Depreciation—$1,600 ÷ 9 yrs. life	$177.77
Average interest[1] at 6 per cent = $\frac{10}{9} \times \frac{\$1,600 \times 0.06}{2}$	53.33
Tires—1 set per year	75.00
Maintenance and repairs, estimated	125.00
Annual fixed expense	$431.10
Fixed expense per day—$431.10 ÷ 300 days	$ 1.44
Gasoline—6 gal. @ $0.22 per gal	1.32
Oil—1 pt. @ $0.60 per gal	0.08
Labor—operator	6.00
Total daily operating cost	$ 8.84
Operating cost per day, without driver	$ 2.84
SAVINGS EFFECTED BY 3 TRUCTRACTORS	
Wages—30 men @ $4 per day	$120.00
Operating cost 3 tructractors—3 × $8.84	$26.52
Wages 3 helpers @ $6 per day	18.00
	44.52
Saving per day—3 tructractors	$ 75.48

This saving repays the cost of the machines in 64 working days.

[1] Allowing for interest earned by depreciation reserve.

Three Clark tructractors[2] used at the South Side Malleable Casting Company have produced savings as outlined in Table 1. Two of these machines have been in use 5 or 6 years and one for one year. All have dump hopper bodies and are used for hauling coal, molding and core sand, and foundry refuse of all kinds. Each machine has a capacity of 2 tons.

These machines take the place of 30 men with wheelbarrows. Maintenance is in charge of one mechanic and requires about 2 hr. time each week.

The Bullard Machine Tool Company uses Clark tructractors to haul chips, refuse, sand and ashes. One of these machines, operating with 2 laborers at a cost of $16.34 per day, has released for productive labor men who formerly received a total of $33.50 per day—a net saving of $4804.80 annually. The second machine has cut costs on its work from $37 to $16.34 per day, which

TABLE 2. CLARK TRUCTRACTOR DATA

The Bullard Machine Tool Co.

OPERATING COST OF TRUCTRACTOR	
Depreciation—$1,625 ÷ 5 yr. life	$325.00
Average interest[1] at 6 per cent = $\frac{6}{5} \times \frac{\$1,625 \times 0.06}{2}$	58.50
Maintenance and repairs	125.00
Total annual fixed cost	$508.50
Fixed cost per working day—$508.50 ÷ 280	$ 1.82
Gasoline cost per day	0.42
Oil cost per day	0.15
Total machine cost per day	$ 2.39
Driver—9 hr. × $0.55	4.95
Labor—2 men × $0.50 × 9 hr	9.00
Total cost of operation per 9-hr. day	$ 16.34
SAVINGS EFFECTED BY NO. 1 TRUCTRACTOR—MACHINE SHOP	
Previous daily cost of handling chips and refuse in machine shop—5 men × $0.50 × 8 hr	$ 20.00
Yard cleaning—previous cost—1 man × 5 hr. × $0.50	2.50
Transporting foundry sand—4 men × 4 hr. × $0.50	8.00
Other work now done with tructractor—2 men × 3 hr. × $0.50	3.00
Total cost of previous method, per day	$ 33.50
Cost, using tructractor	16.34
Saving, per day	$ 17.16
Saving, per year—$17.16 × 280 days	$ 4,804.80

(Pays for tructractor in about 4 months.)

SAVINGS EFFECTED BY NO. 2 TRUCTRACTOR—FOUNDRY REFUSE	
Daily cost of tractor and driver, previous method	$ 15.00
Labor—4 men × 10 hr. × $0.50	20.00
Total daily cost of handling foundry refuse, previous method	$ 35.00
Cost of hauling ashes—2 men × 2 hr. × $0.50	2.00
Total cost of hauling, previous method	$ 37.00
Cost of doing same work with the tructractor	16.34
Saving, per day	$ 20.66
Saving, per year—$20.66 × 280 days	$ 5,784.80

(Pays for tructractor in 79 working days.)

TOTAL ANNUAL SAVING EFFECTED BY THE TWO TRUCTRACTORS	
Saving effected by tructractor No. 1	$ 4,804.80
Saving effected by tructractor No. 2	5,784.80
Total annual saving—2 tructractors	$10,589.60

This represents a return of 326 per cent on the investment and repays the cost of the tructractors in less than 16 weeks.

[1] Allowance for interest earned by depreciation reserve.

[1] See MANAGEMENT AND ADMINISTRATION, May 1924, pp. 557-562; June 1924, pp. 693-694; January 1925, pp. 51-54; February 1925, pp. 153-156, for additional data on savings brought about by material-handling equipment. Also *Management's Handbook*, pp. 741-795.

[2] Data on Clark tructractors and Mercury tractors prepared by the A. C. Nielsen Co.

TABLE 3. MERCURY TRACTOR DATA

Chicago Warehouse and Terminal Company

COST OF OPERATION OF TRACTORS	
Depreciation—tractor—$1,800 ÷ 8 yr	$ 255.00
Depreciation—battery—($755—$75.50) ÷ 3 yr	226.50
Average interest[1] at 6 per cent on tractor = $\frac{9}{8} \times \frac{\$1800 \times 0.06}{2}$	60.75
Average interest[1] at 6 per cent on battery = $\frac{4}{3} \times \frac{(\$755 - \$75.50) \times 0.06}{2}$	27.18
Repairs and maintenance—chassis and battery	175.00
Tires, 1 set	80.30
Depreciation—charging equipment = $\frac{\$1800 \div 15 \text{ yr.}}{7 \text{ tractors}}$	17.14
Average interest[1]—charging equipment—at 6 per cent = $\frac{16}{15} \times \frac{\$1800 \times 0.06}{2} \div 7$ tractors	8.23
Energy for charging—25 kw.-hr. × $0.015 per kw.-hr. × 306 days	114.75
Operating labor—10 hr. @ $0.53 per hr. × 306 days	1,621.80
Supervision of charging and operation = $15 per wk. × 52 wk. ÷ 7 tractors	111.43
Total cost of operation of one tractor per year	$ 2,668.08
Cost of operation of 7 tractors per year $2668.08 × 7	$18,676.56
Depreciation and interest on extra chassis	285.75
Total cost per year of tractors	$18,962.31
Cost per day of fleet—$18,962.31 ÷ 306	$ 61.97
Cost per day of 1 tractor—$61.97 ÷ 7	8.85
Cost per car handled—$8.85 ÷ 114	0.0776
Cost per ton merchandise—$8.85 × 142	0.0623
COST OF MOVING CARS BY USING GANGS OF MEN	
Labor—28 men × 10 hr. @ $0.48 × 306 days	$41,126.40
Cost per car handled—$41,126.40 ÷ 244,800 cars	0.1680
SAVING EFFECTED BY TRACTORS	
Hand method—cost per year	$41,126.40
Tractors—cost per year	18,962.31
Saving per year	$22,164.09
Saving per car handled—$0.1680—$0.0776	$ 0.0904

[1] Allowing for interest earned by depreciation reserve.

represents an annual saving of $5784.80. Thus, the two machines save $10,589.60 per year, which is a return of 326 per cent on the investment. Table 2 shows the detailed calculations.

Another installation of a Clark tructractor at the Champion Porcelain Company saves $8469.50 per year in handling 35,000 lb. of damp clay per day, plus 1½ cars of incoming clay per week. This represents a difference between the former cost of $12,640 and an annual operating cost of $4170.50 for the tructractor, or a return annually of 490 per cent on the investment.

There has also recently been installed a Clark truclift to carry boxes of dust from the grinding room to the stock pile. This machine has replaced 4 men with wheelbarrows, but its total savings have not yet been accurately determined.

A Lakewood Engineering Company tier-lift truck is used at the plant of the Ireland and Mathews Drop Forge Company to change dies. Ordinarily this operation takes 3 or 4 men 2 to 5 hr. and costs about $7 in labor beside a loss of about $105 in idle machine time. The Lakewood Company, in making the above estimate, have calculated that with proper die racks for storage a tier-lift truck will pick up, deliver and place any die weighing up to 4000 lb. in 10 min. at a cost, including production time lost, of $5 per change. If one change per day is made, this will represent an annual saving of $32,100.

Beside this, in the same plant, a tier-lift truck is also used to handle boxes of work and has increased storage space practically 100 per cent in so doing.

The Bucyrus Company uses Lakewood storage battery tractors and trailers to handle castings, scrap iron, wood blocks, etc. Two tractors and 20 trailers with 2 operators and 3 helpers have released 14 men for other work. The tractors run on a definite time schedule and cover regular routes. Signals are arranged at each department to stop the tractor when a loaded trailer is ready for removal, or when the delivery of an empty is desired. The maximum load hauled is 10 tons, or 2 tons per trailer, while the average train load is 5 tons. Special care is taken to eliminate the hauling of useless empties.

Lakewood tier-lift storage battery trucks at the New Departure Manufacturing Company have reduced the number of men required for handling annealing pots in certain operations from 12 to 5 at a saving of $36 per day. These pots weigh 125 lb. filled and are handled on steel skids in lots of 20, the total load being from 1500 to 3000 lb.

The Medina Manufacturing Company, using a Lakewood tier-lift truck, handle and rehandle flywheels through various processes of machining, storing and loading. Previously, machine operators did this work.

TABLE 4. MERCURY TRACTOR DATA

Joseph Eisendrath Company

COST OF OPERATING TRACTOR	
Depreciation, tractor—$1525 ÷ 10 yr	$ 152.50
Depreciation, battery—($680—$68) ÷ 3 yr	204.00
Average interest[1] at 6 per cent on tractor = $\frac{11}{10} \times \frac{\$1525 \times 0.06}{2}$	50.32
Average interest at 6 per cent on battery = $\frac{4}{3} \times \frac{(\$680 - \$68) \times 0.06}{2}$	24.48
Power—4550 kw.-hr. at $0.02 per kw.-hr	91.00
Repairs and maintenance, chassis and battery	125.00
Tires (set costing $75 lasts 9 months)	100.00
Operator—52 wk. × 35 hr. @ $0.50 per hr	910.00
Total annual operating cost	$1,657.30
Cost per day—$1657.30 ÷ 280 days	5.91
Cost per ton, average $5.91 ÷ 100	0.059
SAVINGS EFFECTED BY TRACTOR	
Value of decreased labor turnover in glove factory	$2,500.00
Saving in labor—2 men × 52 wk. @ $25 per wk	2,600.00
Total annual saving	$5,100.00
Annual operating cost of tractor	1,657.30
Net annual saving effected by tractor	$3,442.70

[1] Allowing for interest earned by depreciation reserve.

Loading cars for shipment required from 5 to 9 men and an average of 5 hr. time. Under the new method flywheels are kept and carried on skids holding 40 wheels, each weighing 100 lb., and in the shop the savings by this scheme amount to $10 per day. In shipping, one operator and 2 men, using the truck, load a car in 1½ hr. at a saving of $20 per car, or a total of $2080 annually. Part of this saving has resulted from a systematized method which the use of the truck brought about.

The transportation department of the Chicago Warehouse and Terminal Company uses 7 Mercury tractors to move 800 freight cars per day at a cost of $0.0776 per car, and a comparison of this method with hand labor is given in Table 3. This company operates through 65 miles of tunnels in the city of Chicago and transfers merchandise to and from railroad freight houses for a great many different concerns. Beside this it handles coal and cinders.

TABLE 5. ROOTS CUPOLA CHARGING HOIST DATA

The Davies and Thomas Company

COMPARATIVE COST OF CHARGING CUPOLAS BY MECHANICAL AND HAND LABOR METHODS

Daily melt—150 tons
Cupola size—84 in. inside diameter
Charges—10,000 lb. pig and scrap iron
1,000 lb. coke

COST OF MECHANICAL METHOD

Labor cost:	
Wages of one operator per hr.	$0.60
Wages of 2 helpers @ $0.50 per hr.	1.00
Total labor cost per hr.	$1.60
Cost of electric power:	
Magnet....20 amp. ×230 volt =4.6 kw.	
Hoist motor....40 amp. ×230 volt =9.2 kw.	
Trolley....11 amp. ×230 volt =2.5 kw.	
Total kw.-hr. (operating 50 per cent of time) =8.1 kw.	
Electrical operating cost @ $0.03 per kw.-hr.	0.24
Depreciation of equipment:	
Cost of cupola charging machine and magnet (installed)	$8000
Depreciation—10 per cent per year	800
Depreciation per hr. for each 8-hr. day	0.33
Total operating and depreciation cost per hour	$2.17
Cost per ton (150 tons per day)	$0.11

COST OF HAND LABOR METHOD

Labor cost:	
Wages of 9 laborers @ $0.50 per hr.	$4.50
Power cost:	
Operating elevator per hr.	0.06
Equipment cost:	
Cost of hand charging equipment	unknown
Total cost of hand charging per hour	$4.56
Cost per ton (150 tons per day)	$0.24
Net savings per ton—$0.24—0.11	$0.13
Net savings per day—$0.13 ×150	$19.50

The freight cars weigh 3500 lb. and carry an average load of 2500 lb. They are 13 ft. long, 4½ ft. wide, and 4½ ft. high. Five freight elevators are used to reach different levels and at these points the Mercury tractors are used to spot the company's freight cars.

A Mercury tractor is used in the tannery of the Joseph Eisendrath Company to handle trailers in which boxes of fleshings are placed. While purchased primarily for this purpose, the tractor has been profitably put to other uses, such as hauling hides, moving in freight and spotting freight cars. It is employed 35 hr. a week, hauling an average of 100 tons per day. The average length of haul is 300 ft. and on the level, but the tractor is called upon to go up one 10 per cent grade with a trailer and load of 3000 lb.

Elimination of the unpleasant odor by handling the fleshings under this new plan has reduced labor turnover in the glove manufacturing departments of the plant. The factors of savings are listed in Table 4.

The Davies and Thomas Company uses a cupola charging hoist installed by the P. H. and F. M. Roots Company to increase production and reduce labor expense. The 84-in. cupola to which this equipment is applied has handled a daily tonnage of 150 tons, made up of successive charges of 10,000 lb. of iron and 1000 lb. of coke. The hoist is, however, capable of handling a daily load 100 per cent greater than the above.

The iron is picked up by magnet from the storage yard and carried by the charging machine to the cupola. Each cycle of operations requires 6 min. per 10,000 lb. of iron. Formerly the work was done by hand by a crew of 9 men, 6 of whom have been released by the charging machine. The savings of $19.50 per day, Table 5, would have been $40 at 100 per cent capacity.

Other cases of savings are presented in Table 6.

TABLE 6. DATA ON ECONOMIES OF VARIOUS TYPES OF EQUIPMENT

Comparisons with hand methods or semi-mechanical equipment given where available. In other cases operating data only are tabulated.

Item	Type of Apparatus	Plant Where Installed and Date	Make	Handling Service for Which Used	Number Used	Loads Handled	Men Required	Men for Hand Methods	Cost of Handling by Hand	Cost of Handling by Equipment	Total Savings by Use of Equipment per Yr.	Additional Advantages Credited
1	Lift truck	Northwestern Yeast Co	Barrett-Cravens	Boxes and shooks	.....	.....	1	.....	.....	.....	$900 per truck	.....
2	Tructractor[1]	Universal Winding Co. 1923	Clark	Sprues and foundry refuse	1	1 ton	2	6	$6706.00	$3578.84	$3127.16	.....
3	Tructractor	Mason Machine Works Co., 1919 and 1922	Clark	Castings	2	Up to 3000 lb.	1	4	$4957.20	$3304.80	$1652.40	.....
4	Tructractor	Blackmer and Post Pipe Co.	Clark	Coal	1	1500 lb.	1	.....	.....	$1762.70[2]	.....	Saves congestion
5	Tructractor	A large pottery plant, 1918 and later	Clark	Coal, clay, etc.	6	1300 to 1800 lb.	5	.....	.....	$0.678 per mile	.....	Simplifies material handling
6	Duat tractor	Crooks Terminal Warehouse	Clark	Freight	1	6 trailers, or 15000 lb., etc.	7	6	$0.282 per ton	$0.125 per ton	$0.157 per ton	Cuts handling time to one-third
7	Tier-lift truck	J. Manz Engraving Co.	Lakewood	Paper	1	4000 lb.	4	10	$1.07 per ton	$0.50 per ton	$0.57 per ton	.....
8	Tier-lift truck	Hummel and Downing Co.	Lakewood	Rolls of paper	1	Two 1300 lb. rolls	1	4	$0.10 per roll	$0.02 per roll	$0.08 per roll	Doubles storage space
9	Tier-lift truck	Passaic Metal Ware Co	Lakewood	Tin plate	.....	.....	5	15	$0.64 per ton	$0.24 per ton	$0.40 per ton	.....
10	Tier-lift truck	Barrett Co.	Lakewood	Barrels, bags, drums, etc.	.....	.....	5	9	.....	.....	.....	Saves considerable time
11	Tier-lift truck	Detroit Free Press	Lakewood	Rolls of paper	.....	1890 lb. rolls	2	5	.....	.....	$25 per day	Saves time Doubles storage space
12	Tractor	Western Warehousing Co., 1920	Mercury	Freight	.....	.....	1	5	$7722.00	$2240.19	$5481.81	.....

[1] Equipment cost: Items (2) $1600; (4) $1700; (5) $1600 each; (6) $1000; (12) $2050.
[2] This is exclusive of shoveling when loading. Cost per ton, excluding shoveling, is $0.13; including shoveling, $0.305

Electric Tractors Aid in Shipping

THE electric truck or tractor is sometimes called upon to perform rather unusual duties. Its applications to many forms of handling operations in every branch of industry are familiar to all who are in any manner acquainted with this class of equipment. But

FIG. 1 METHOD OF RAISING BOX ON DOLLY

there seems to be no limit to the number of ways in which it has demonstrated utility and adaptability. A few cases are cited here.

Automobiles are shipped to the Dutch East Indies from the docks of the Java Pacific Line in San Francisco. They arrive at the dock boxed and in freight cars. The floor of the dock is at an elevation which brings it on a level with the floor of a railroad car.

Boxed automobiles on incoming cars are raised, as shown in Fig. 1, by means of a lever mounted on two wheels and operated by 6 men. Next, an electric tractor is connected to the box by a rope, and by re-

FIG. 2 HANDLING BOXED MOTOR CARS WITH TRACTOR

peated backing up it jerks the box forward a few inches at a time until it is partly on the dock. Then the box is raised still higher by the level and a dolly is placed under it. Finally the electric tractor tows the box either to the ship's side, or to the point on the dock where it is to be stored until ready to be placed aboard a vessel.

In loading onto the ship, the lever is again employed so that the dolly can be removed. Rollers placed under the box then enable it to be pushed to the side of the boat for hoisting aboard.

A similar method is used at the docks of the Oceanic Steamship Co., San Francisco. Fig. 2 shows a tractor pulling a dolly on which is a boxed automobile.

A great deal of baled cotton is handled at San Francisco docks and in this work the electric tractor has also been used with considerable economy.

The cotton is stored in high piles reaching to the roof of the dock. When moving it out, it was formerly

FIG. 3 METHOD OF PULLING DOWN BALES OF COTTON

necessary to put several stevedores at the work, and they had to climb to the top of the pile and throw down the bales.

Now a stout rope with a steel-hook at the end is fastened to the tractor. This hook is caught into one of the steel bands around a bale of cotton at the bottom of the pile, as shown in Fig. 3. Then the tractor backs away and pulls this bale out, with the result that those above it fall to the floor and are thus accessible for loading. Fig. 4 shows how effective this method is in getting the bales down. As stated, it has saved the expense of several stevedores previously employed for this purpose.

FIG. 4 TRACTORS ARE ECONOMICAL IN HANDLING COTTON

How Many People Will Buy the Product You Have to Sell?

Possibilities in a Study of Your Market

By ROLAND G. E. ULLMAN

McLain-Simpers Organization

A NICE, easy question! How in ——, well any way, how can you tell? How can you?

The dismal chorus of a thousand try to drown in a sea of ridicule the ten who dare the question. The green waves of precedent, of can't-be-done, come roaring in to engulf this handful who seek to measure the tide of sales—come roaring in—and subside. Some of the ten always win.

It is not, or should not be, any harder than to get an answer to the question: How many people will die tomorrow in New York City, or in Walden, Colorado?

The life insurance actuarial will tell you almost exactly. In New York his estimate will be astoundingly accurate. In Walden, the law of averages will not be quite so helpful, because there are only 500 inhabitants. In the entire United States his figures will be 98 per cent right.

You say this is a far-fetched example and does not prove anything. Perhaps, but the casket manufacturers, the monument makers and the undertakers can all gage their potential business from a study of vital statistics. Each one can apply the actuarial base rate to his own town or district in combination with the right coefficients for his own business-getting facilities, for competition and for the personal equation. The result will be a fairly accurate index of the volume of business each one can expect to get.

Through market analysis the scientific method of seeing facts, organizing them for use, drawing sound conclusions, and making wise decisions is applied to the work of distributing manufactured products. The possibilities of such an analysis are too little appreciated. Mr. Ullman forcefully declares, " . . . the manufacturer can tell almost to a dollar how big a slice of the total business available he should get as his share, and how to go about getting it."

Accuracy of an Analysis

If a market is analyzed and if this is done thoroughly and with due regard to the governing factors, the manufacturer in that field can tell almost to a dollar how big a slice of the total business available he should get as his share, and how to go about getting it.

The first thing to do, then, is to apply the yardstick to the market. No blanket formula for procedure can be followed.

Safety-pins are an established staple used by millions of people. Demand is almost fixed. Consumption cannot be increased much faster than the growth of population. But a continuous centrifugal is not a staple. An individual will not buy one for his personal use, but a manufacturer of chemicals or of sugar or of any one of a number of other products will find such a machine tremendously useful in obtaining better and more uniform production and in reducing his manufacturing cost.

But both of these widely different cases have certain fundamentals common to all products. Their existence is invariably dependent upon a human need or a human desire. Their use is dependent upon knowledge of their existence and upon the ease with which they can be obtained as determined by price and distribution, both of which, in turn, may depend upon competition.

Safety-pins are used so generally that practically every American family is a prospect. There are approximately 24,000,000 families in the United States. It is then a question of ascertaining the average number used per family to know the total volume of sales.

Safety-pins are sold by stores which, in most cases, buy from jobbers. The channels of distribution have been established so long that it would be difficult to upset the existing order without a great expense. The available volume of business to any one manufacturer is probably not large enough to justify any departure from the established methods of distribution.

Safety-pins are so inexpensive and used in such quantities that they can be bought nearly anywhere. They are all much alike—no great change or improvement of design can be made. Competition is entrenched. Prices are close, profit is governed largely by volume production.

The purchase of the average store will be so small in dollars that it would not pay to sell direct to the dealer. The jobber is the logical and least expensive course. He sells so many things that his selling cost is low on such a staple.

If a manufacturer of safety-pins wishes to increase his sales, it is evident that he must be prepared to take business away from his competitors. This may not be as big a task as it appears. There are always weak spots in the competitive armor in a country of 110,000,000 people. There are nearly always places where distribution can be improved and sales increased.

Sources of Information

Let us take a totally different product. Perhaps our continuous centrifugal will do. It is not a staple. It is a special, highly technical machine, patented probably, and therefore subject to only indirect competition. It is designed to extract liquids by centrifugal separation. It can be used advantageously in the manufacture of salt, of sugar and of many commercial chemicals where previously the ordinary type of centrifugal extractor was used. This was always idle while it was being charged or discharged. This new machine can be loaded continuously up to its capacity and it discharges at a uniform rate and continuously. The machine is never idle except when it needs repairs or replacing of worn parts or when the plant is shut down.

The problem here is essentially one of analyzing manufacturing processes. In how many industries is centrifugal extraction practiced? Are there any others which might profitably adopt such a process?

There are in the neighborhood of 150 kinds of industries that involve manufacturing or preparation processes to make the product marketable. Government statistics from the Census Bureau will provide anyone with a list of these. Then each one can be studied separately.

The industrial and scientific publications will be able to help track the processes to their respective lairs; various bureaus of the Department of Commerce and the Department of Agriculture will add their contributions—and very valuable these will often be—if their aid is solicited.

The average manufacturer has no conception of the amount of tremendously valuable information that is stored up in Washington, available for use if only he can find out where it is.

The writer recalls one occasion when a tool manufacturer wanted to find out how big a market he had. To everyone's surprise, there seemed to be no figures available despite the fact that the tools in question were of a type found in nearly every household and used by laborers and mechanics everywhere.

Analyzing the Chief Sales Asset

This manufacturer's chief sales asset lay in the unusually long life of his product. His tools lasted several times as long as similar ones made in the usual way. What he needed to know was the total possible market at the start and then the replacement when, or if, he saturated the market. On these facts would depend the size to which his factory could be safely expanded, the extent of the sales force he could build up, the amount of advertising he would be justified in doing, and the other forms of capital investment he would have to make.

Diligent search revealed nothing in the usual places. There was no apparent accumulation of figures for this particular industry. It seemed that the only course open was to laboriously assemble figures in a territory large enough to provide an actuarial basis for the entire country. A start was made, but this slow, expensive process was not completed. Someone had had an inspiration and had gambled the price of another trip to Washington. In the income tax division of the Treasury Department was found the information that could be translated into the desired figures on the quantity of tools produced by all makers.

Market analysis provides a sound foundation of facts which removes many usual business risks. It is an instrument of the utmost value when rightly used. Many sources of helpful information are available in evaluating a market and its possibilities: Government statistics in Washington, trade and industrial magazines, industrial and economic publications, records of manufacturers' associations, and others. Each problem may require an individual attack, but the established methods are applicable to any industry.

With these figures as a guide, the manufacturer could plan intelligently. By applying the degree of depletion that governed the life of his tools to the total volume, he could discount his future replacement business. By combining all of his known factors, he could determine in advance the downward trend of his manufacturing costs as volume of sales increased.

This, in turn, gave him a basis from which he could arrive at the right amount to spend in sales effort and in advertising. It made possible the practical application of this formula: Cost of raw materials + manufacturing cost + manufacturing overhead + administrative overhead + distribution costs (including sales expense) + advertising + profit = sales price.

Removal of Business Risks

In this way the sales price of each unit included all of the factors for the continuation and the expansion of the business. Every unit sold paid for the materials of which it was made, paid for the labor and power required in manufacture, paid its own selling expense, and paid for its share of the advertising that was telling prospects of the existence of tools of such merit.

The careful, exhaustive study of the market in this case, as in many others that have come under the writer's attention, made possible a more rapid growth on a sound foundation of facts with many of the usual risks of business removed.

The same methods are applicable to any business or industry. The results depend entirely on the study made to fit these methods to the individual case.

A Production Schedule for Factory Accounting Work

By DONALD ROSS

General Auditor, Liberty Yeast Corporation

PLANNING production in manufacturing plants has received much attention during the past few years, and many worth-while methods have been prepared and effectively used in connection with routing and scheduling the products of the factory. It is not generally realized, however, that the service departments of a manufacturing company should and can be organized on the same basis and the same good results attained therein as in the productive departments. Of the service departments to which production planning methods may be applied, the accounting department is most important. It, like all other service departments, produces certain results periodically and these results may be increased and dealt with quite as effectively as the material things dealt with by the processing departments of a factory.

The average accountant is a sensitive individual and in most cases regards his work as a profession. While he is very much interested in all plans for establishing time standards for the shop and will industriously try to systematize his own work, he usually resents being held down to a definite time schedule. In this he is partially right, as "rushed" figures are often inaccurate and any time standards established should be worked out with this consideration in mind.

The old idea of an accounting department functioning solely for the purpose of checking past records has long since gone into the discard, and it is now recognized that accounts are kept primarily in order to supply the operating and executive departments of the business with *prompt* and *accurate* information. The executives of any business are fully aware of the importance of receiving financial statements as promptly as possible, and the cry of "when are we going to get our figures" is well known and occurs with irritating regularity in many business offices.

Most business concerns know in a "general way" at what time of the month their regular financial and operating reports may be expected. In the same way the accounting department head has a "general" idea of what each member of the department is doing, whether this or that individual is busy or not, and when the various accounting records should be completed in order that the executives of the business may receive the financial and operating statements at the proper time. Where a large volume of accounting work is handled, or where the successful operation of the business demands considerable analysis of detail, "general" methods are inadequate, and the substitution of a system of time schedules for the accounting department is necessary. This article purposes to show how one such system has been operated successfully and the results of scheduling.

The product of the company is manufactured in three plants, two on the eastern seaboard and one in the middle west. From these plants the product is shipped to branches in 70 of the larger cities east of Denver and sold and delivered to customers by the company's own salesmen.

As the production is "continuous" the problem of manufacturing cost accounting is a comparatively simple one. Each plant, however, keeps a separate set of books which are controlled by the general books at the main office, and compiles monthly statements giving full operating details of the cost of producing the main product as well as the by-products. The office staff at each plant consists of an accountant, a storekeeper, who also acts as time clerk, and a stenographer.

No accounting work is done at any of the 70 sales branches. All statement work is concentrated at two points, a division office in the west and the main office in the east.

In addition to the usual financial statements, such as balance sheet, income statement, manufacturing cost statements, etc., the accounting department compiles monthly comparisons of actual operations with a budget. The budget system is complete in all detail and involves a series of figures and control charts for each plant and for each of the 70 branches. The budget comparisons are disseminated among the various department heads, who report to the management regarding any discrepancies between the results obtained and the budget.

Simultaneously with the installation of the manufacturing cost system and the budget system, a study was made of the time consumed by each respective member of the accounting department in taking care of his work. General duties and responsibilities were assigned to each person in the usual way. Each individual in the accounting department was then instructed to keep a diary. Notes were made in each diary as to the work done each day, the time consumed in doing the work, the important reports received and comments as to reasons for delays or other remarks that might serve as recommendations for improvement.

After these diaries had been kept for a little over a month, a careful analysis was made of each individual's work, and the several diaries were studied by compiling a composite diary for the department. Charts were then prepared showing a chronological list of the accomplishments of each individual during

the time the diaries were kept. With this information reduced to graphic form, it became apparent that the following discrepancies needed correction:

1. There was an overlapping of duties.
2. There was a large amount of time wasted because certain individuals were waiting for work to be finished by others.
3. Some members of the accounting department were doing a great deal more work than could be handled efficiently, and other members were not doing as much work as could be done, due in most cases to no fault of their own.

The next step was to lay out for each individual in the department an ideal working arrangement. This was done by the department head conferring with each member of the department separately and going over the results as shown by the diary and considering how the person's work would fit in with the work done by the other members of the department. After this study had been completed, a departmental chart was drawn up. (See Fig. 1.) This chart varies somewhat from the original one in that some of the schedules assigned were found to be subject to correction, but, generally speaking, the chart in use today is very much the same as the one first drawn up. The horizontal lines on the chart indicate the work to be done and the arrows indicate, in each case, when the work is to be completed. Where there are blank spaces for any individual for any date, the individual concerned is working on special assignment.

Separate copies of the chart were furnished each individual, together with a full explanation as to the object of establishing time schedules for the accounting department routine. The results obtained by the establishment of this system have been very encouraging both from the standpoint of the efficiency of the department and from the standpoint of the interest shown by the accounting department personnel. Since the adoption of this schedule, in no case has anyone fallen behind the time set, and in most cases there has been a disposition on the part of the personnel to "beat" the schedule. A spirit of team work has also been effected which perhaps could not have been done in any way, as each member of the accounting staff is inclined to regard the compilation of his work on scheduled time as a sort of a game which must be played fair in order to give the other fellow a chance to live up to his part of the general scheme.

The diary work and the study of the duties and responsibilities of the personnel in the accounting department probably covered a period of two months, but during that time the regular work of the department was not interfered with in any way. Prior to the adoption of this scheme, the accounting department executive did not know when special assignments could best be made and was not sure of getting out important reports on any particular date. Not only was this true, but previously several members of the accounting staff had to work late at night for several nights each month in order to prevent the next month's work from piling up. With the present system the work is completed during office hours. There have been no increases in personnel; in fact, the number of accounting department employees at the plants has been reduced and all of the statement work has been taken over from the larger branches.

The inauguration of the above plan has proved that the cost and time involved in installing such a system is inconsiderable when compared with the results obtained in increased efficiency of handling work.

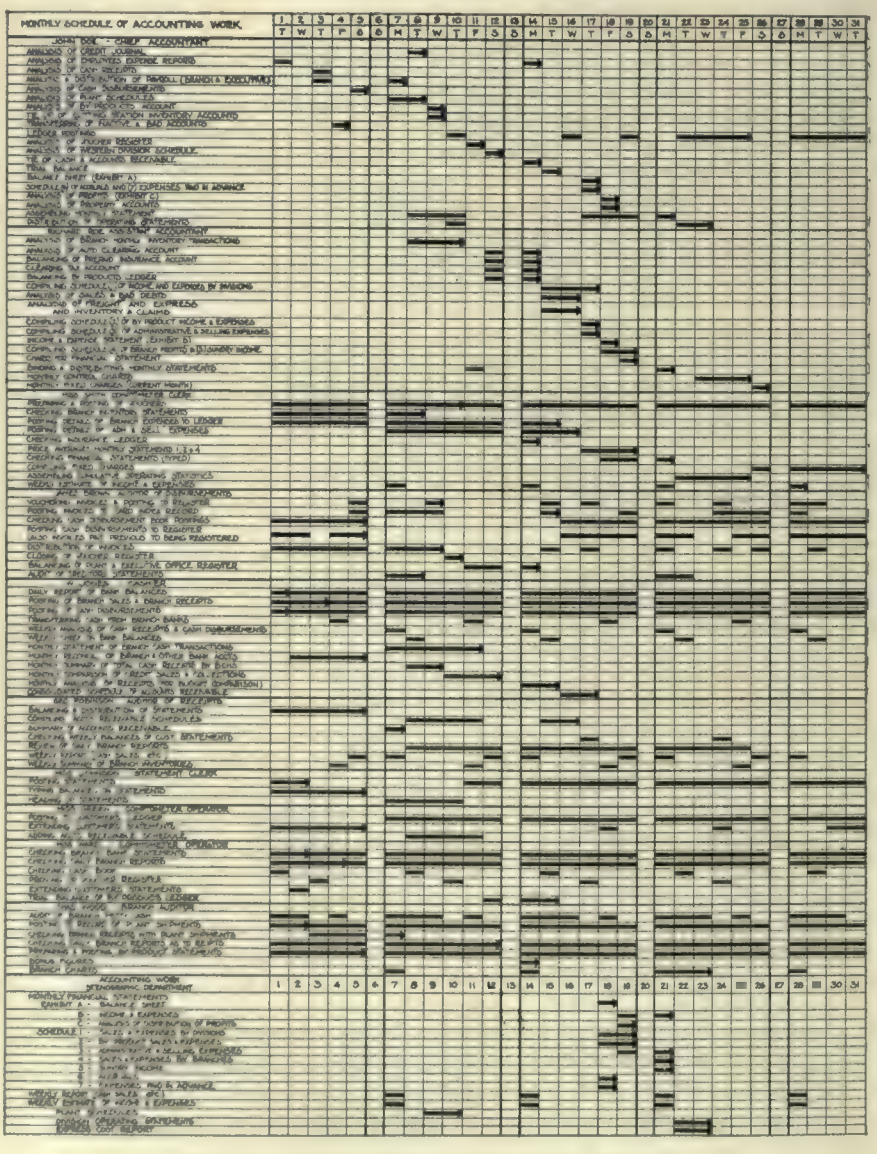
MONTHLY SCHEDULE OF ACCOUNTING WORK
JOHN DOE - CHIEF ACCOUNTANT
ACCOUNTING WORK
STENOGRAPHIC DEPARTMENT
MONTHLY FINANCIAL STATEMENTS
EXHIBIT A - BALANCE SHEET
SCHEDULE 1 - SALES & PROFITS BY DIVISIONS
BRANCH CHARTS

FIG. 1 A DEPARTMENTAL PRODUCTION SCHEDULE

Financing Automobile Sales Abroad

Present Methods and Need of a New Export Link

By GEORGE F. BAUER

Secretary, Foreign Trade Committee, National Automobile Chamber of Commerce

WITH relatively little assistance such as the domestic dealer receives in financing the purchasing, shipping and retail sales of motor vehicles, automotive dealers abroad, nevertheless, disposed of more than 12 per cent of all American cars consumed last year. As startling as this percentage is, it would have been considerably larger if financing facilities like those in the United States had been adapted to peculiar conditions arising in international automotive trade.

Present Financing Methods

At present, financing of export shipments of motor vehicles is still carried out chiefly on the basis of confirmed irrevocable letters of credit in New York. (See Fig. 1.) This means that, while the domestic dealer pays interest for very short periods, the foreign dealer is compelled to utilize his credit resources with his local bank from the very time the order is placed, and that interest charges begin at once. It further signifies that the credit established by the foreign bank on behalf of the dealer must be guaranteed by an American financial institution of recognized standing before the manufacturer proceeds with preparations for the shipment. Naturally, fees are considerable and the limitation put on the dealer restricts use of his capital mostly to financing operations and allows little margin for development of sales organization and administration of business.

Up until not so very long ago, many drafts under a confirmed irrevocable letter of credit were made payable at the inland city in which the factory was located. In the last few years, however, the attitude of the manufacturers in this matter has changed somewhat and the customary practice now is to allow for payment of the sight draft at a seaport. (See Fig. 2.)

Under the former arrangement interest became chargeable to the foreign dealer as soon as the automobiles were placed in a freight car at the factory. With the latter modification, however, the time for charging interest has been postponed until the vehicles are placed aboard the vessel and the documents, including the ocean bill of lading, are presented to the bank at the seaport. A slight saving in interest charges has, as a result, been made available to the foreign dealer.

Some firms, such as the Packard Motor Car Company, for instance, have proceeded a little further in arranging more favorable financing conditions by allowing the use of bankers' acceptances as a means for payment of export shipments. This arrangement, nevertheless, provides for confirmation by an American bank of the credit established by the foreign financial institution on behalf of the dealer. A decided advantage to the dealer, however, results from the use of them, in the fact that the stipulation of sight drafts, payable at an American seaport, is avoided and is replaced by time drafts running for 60 days or more after placing of shipment on vessel. This period is usually ample to allow for both arrival of vehicles at foreign destination and possible sale before maturity of drafts.

The manufacturer, in this instance, too, presents his draft to the American bank, which does not, however, as in the former cases, pay him in cash for the full amount, but instead accepts, or guarantees, payment of draft on due date. The draft thus becomes an obligation of an American bank and the manufacturer can readily retain it among his receivables until date of maturity. Firms with ample cash balances at their banks are very likely to do this.

The manufacturer who desires to have cash immediately, however, can present the acceptance for discount at any financial institution, as there is always a large demand for bankers' acceptances. It is true that, under this procedure, the manufacturer foregoes an amount equivalent to the interest for the time that the obligation remains outstanding. This deduction, however, is insignificant in view of the very low rate in the open market for negotiable paper of this kind.

Discounting Charges Paid by Dealer

Instances will also arise, in connection with the use of bankers' acceptances, where the manufacturer feels that the charge of discounting should be passed back to the foreign dealer who has been accommodated by this deviation of a customary practice requiring full cash for the shipment at seaboard. Even then the dealer is likely to benefit, as the interest charged in many foreign countries is frequently several times larger than that asked in the United States. With large shipments over a long period of time, the saving is great.

The drawback to any of the foregoing methods of financing will be found in the great absorption of credit that the foreign dealer may have with his local bank. Even outstanding acceptance credits will often be the

cause of reluctance of a foreign banker to accord to the dealer any additional assistance along other lines essential to the expansion of business facilities. Accordingly, an urgent demand exists for means of obviating this need of resorting to foreign banks in connection with the financing of shipments.

Requests are, therefore, frequently made for shipments on what might comparably be considered open accounts. A modification is the arrangement whereby the shipment goes forward to the foreign destination and payment is arranged by the dealer solely at the port of entry.

Another arrangement may provide for presentation of documents against a 60- or 90-day draft to be accepted by the dealer upon arrival of the goods at destination. (See Fig. 3.)

Either of these transactions is synonymous with selling an open account to the dealer. Firms that consider them at all are likely to ask for an initial deposit by the dealer and also arrange for hypothecation of the vehicles until the final payment has been made.

It is evident that only manufacturers with large organizations overseas and capable of thoroughly investigating the standing of their dealers will be inclined to enter into these transactions. General Motors Acceptance Company, which does considerable export financing by shipping to foreign dealers and drawing sight drafts against them, has an excellent organization to check up credit factors in various parts of the world. There is, however, a direct recognition of the fact that credit extension involves knowledge not of manufacturing but rather of banking. Evidence of this is seen in the establishment of the General Motors Export Corporation and the General Motors Acceptance Corporation under the parent General Motors Corporation.

There are other companies which are anxious to provide similar facilities to their foreign dealers, but which are reluctant to undertake the financing themselves. The Studebaker Corporation of America has solved such a problem by arranging for financing of export shipments of Studebaker cars through the Industrial Finance Acceptance Corporation, which, in addition to financing domestic business for this manufacturer, is also extending similar services to places abroad.

Other manufacturers and foreign dealers are arranging to cover this gap in a different way. Various export commission houses have developed along lines to cater specially to this need. Reputable dealers in Argentina are readily able now to have shipments financed for them by such export firms upon payment of a commission amounting to about 2½ per cent plus a nominal interest charge. The commission house with branch offices at New York usually endorses the drafts drawn on the Argentine dealer and presents them for discount at an American bank. The export firm, by becoming subject to recourse, tends to act as an intermediary between the manufacturer, who desires to avoid endorsement of dealer drafts, and the banker, who believes that endorsement by a responsible firm in the United States is essential. How much automotive paper the export firm can present for discount will depend entirely on its credit rating with the bank, which considers the endorser first and the collateral available in the draft second.

In trade with Australia, facilities of this kind are specially provided by such firms as Kemsley, Millbourn and Company, Ltd., and Arkell, Douglas, Inc. In fact, the development of that country as the major market for American motor vehicles may be traced to the excellency of financing facilities which have been pro-

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FOREIGN DEPARTMENT
CABLE ADDRESS: NATCOMERCE

ADVICE OF CONFIRMED CREDIT

The documents eventually presented by you must be in exact conformity with the terms of this credit. If the terms hereof are incorrect or unsatisfactory, please communicate immediately with your principals abroad and request that they have our correspondent send us amended instructions.

MENTION THIS CREDIT NUMBER AND DATE ON ALL DRAFTS AND COMMUNICATIONS

Credit No. 844 March 17, 1925

USA Automobile Company
Detroit, Michigan

Gentlemen:

For account of our correspondent mentioned below, as ordered in their radiogram dated March 17, 1925, we herewith open a CONFIRMED CREDIT in your favor for the amount of about $10,000 (ABOUT TEN THOUSAND DOLLARS) for account of aktiebolaget J. G. Ungey, Stockholm available by draft on us at sight together with:

Ocean Bill-of-lading in full set

Invoice in triplicate.

All documents to be in form satisfactory to us to represent and cover the following merchandise: Motor cars and parts
Freight payable at destination
We are advised insurance is provided abroad

Shipped per steamer to Malmo free port

SEE REVERSE HEREOF FOR ADDITIONAL CONDITIONS IF ANY.

This credit expires on May 15, 1925 Your draft must be presented on or before that date.

THIS CREDIT OPENED BY ORDER AND FOR ACCOUNT OF
Swedish Bank
Stockholm, Sweden

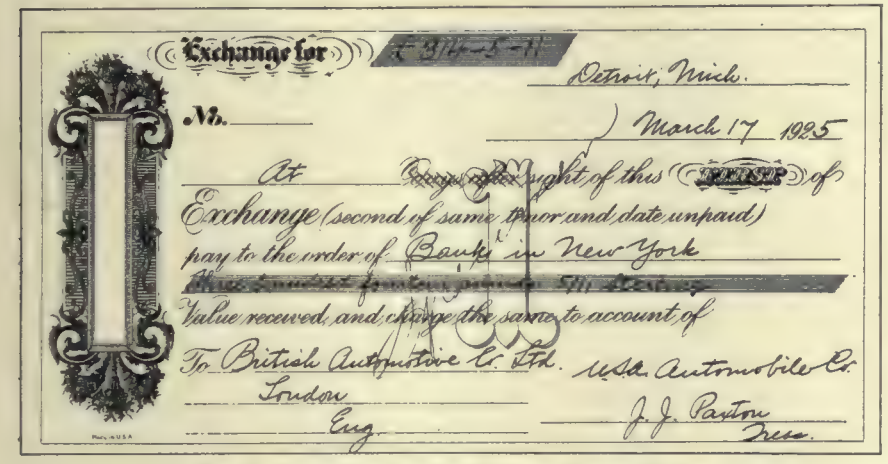
Yours very truly,
Wm B. Mitchell
Assistant Cashier.

Assistant Manager Foreign Department.

FIG. 1 CREDIT ESTABLISHED JOINTLY BY A FOREIGN AND DOMESTIC BANK

vided to take care of wholesale and retail sales.

The burden of financing sales of cars to customers has been taken off the dealer in Australia since the organization of an automotive finance company. The initial plan was prepared by W. E. Harrison, formerly Secretary of the Motor Traders' Association. The capital


Exchange for £ 314-5-11

Detroit, Mich.

No. _____ March 17 1925

At _____ sight of this FIRST of

Exchange (second of same tenor and date unpaid)

pay to the order of Bankers in New York

Three hundred fourteen pounds 11 cents

Value received, and charge the same to account of

To British Automotive C. Ltd. USA Automobile Co.

London

Eng. J. J. Paxton Treas.

FIG. 2 CREDIT TO DEALER AGAINST SIGHT DRAFT

was secured from dealers and general investors in Australia. Within 7 months the company proved its worth by providing 16 per cent dividends and by being in a position to refuse additional business. During that time it was necessary to take back only 2 cars and these were resold at profit, in view of the down payment of 35 per cent exacted from the first buyer.

So much needed have the services of a financing company proved to be in Australia, that a movement is now on to organize others and thus allow dealers to utilize the greater part of their capital in extending their business organizations.

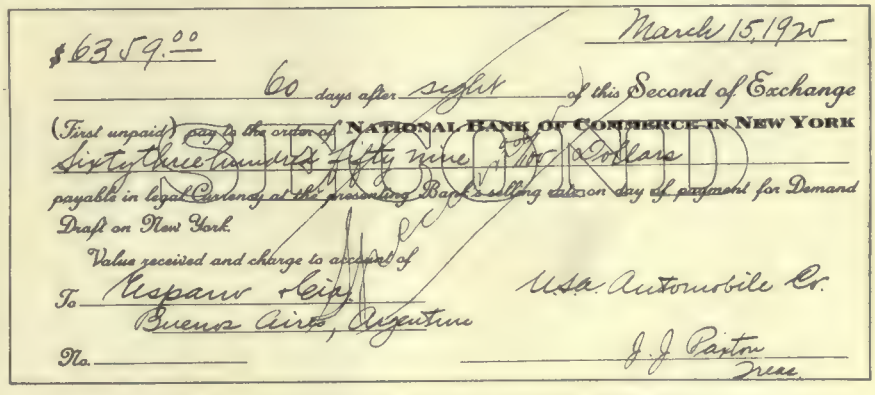
It is doubtful whether dealers in countries less fortunate as regards volume of business will be as readily favored with relief in the financing of shipments and retail sales. Exports to some countries, by individual manufacturers, do not always represent sufficient value to warrant special finance organizations. Then again, the amount of capital available for investment in an automotive finance company to serve local needs may be inadequate. Under the circumstances it is probable that provision for automotive finance in many countries must originate in the United States, which has, moreover, an ample supply of gold.

Any plans dependent on the United States for more adequate financing of foreign automotive trade will very likely be based on the collateral value inherent in automobiles. It is generally acknowledged throughout the world that bonds, stocks, or commodities such as grain or cotton, can readily be offered as collateral for any loan that may be desired by the owner of such things. Automobile dealers in Chicago are enabled to receive direct financial help by putting up their vehicles in the warehouse of the company that is willing to accord loans on security of that kind. In fact, the whole existence of domestic automotive financing companies is established on the principle that motor vehicles represent collateral values on which loans may be extended, particularly as titles may readily be retained through chattel mortgages.

In export trade, however, the attitude is not generally taken that motor vehicles alone are sufficient security for loans. Lack of this recognition has done more than anything else to retard development of foreign automotive financing to proportions sufficient to meet existing and potential needs throughout the world.

There are, perhaps, definite and very valid reasons why such little progress has been made. Underlying all will be found a divergency of opinion regarding the respective functions of all parties concerned with financing transactions in automotive export trade.

Many assume that the manufacturer is the logical person to extend more favorable credit facilities. In such cases cognizance is not taken of the large demand on capital in any industry organized for large-scale production. The low cost of articles produced under methods of mass output is possible only as strenuous efforts are made to keep down overhead, which includes interest on capital. In fact, it is quite doubtful whether even some of the strongest automotive companies could stand the financial strain of purchasing huge supplies of materials, arranging for payment of a large labor


$ 6359.00 March 15, 1925

60 days after sight of this Second of Exchange

(First unpaid) pay to the order of NATIONAL BANK OF COMMERCE IN NEW YORK

Sixty three hundred fifty nine Dollars

payable in legal Currency at the presentary Bank's selling rate on day of payment for Demand Draft on New York.

Value received and charge to account of

To Hispano Argentina USA Automobile Co.

Buenos Aires, Argentine

No. _____ J. J. Paxton Treas.

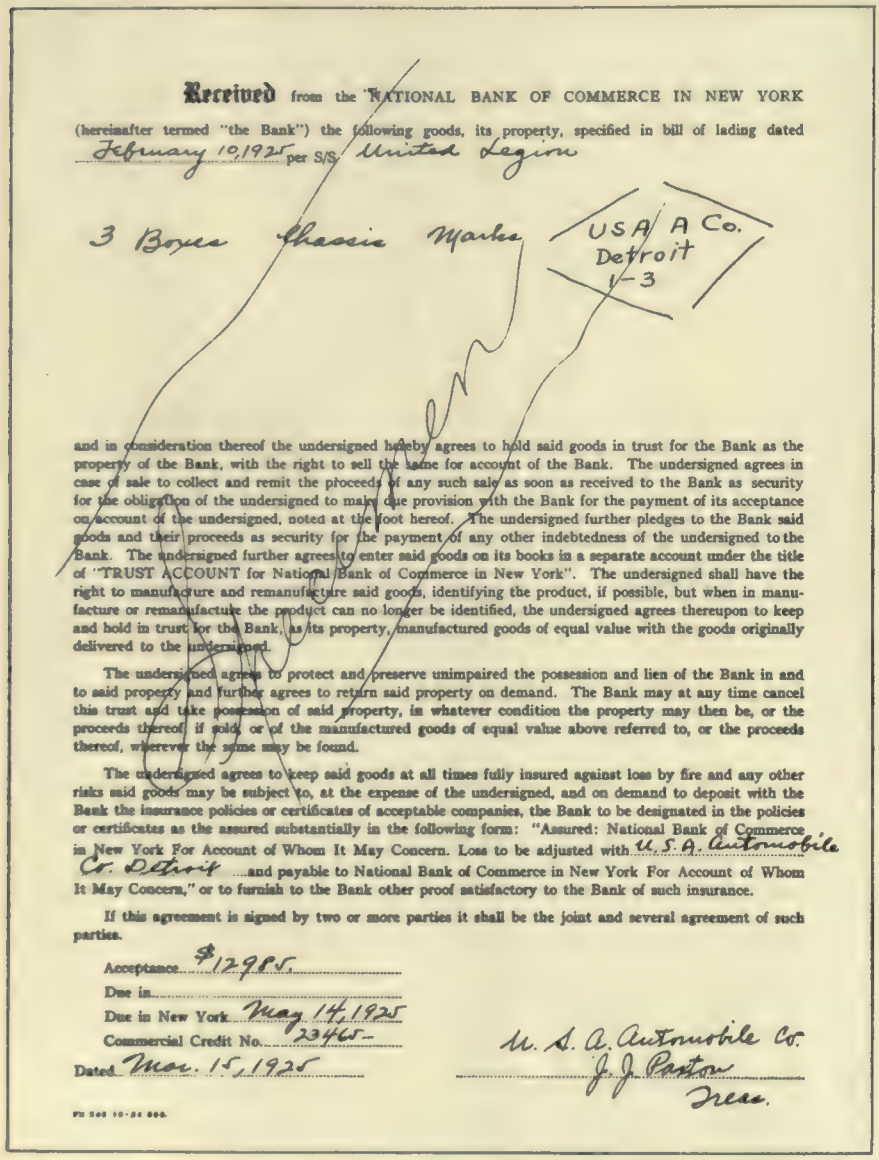
FIG. 3 CREDIT TO DEALER AGAINST TIME DRAFT

pay-roll, and taking care of administrative expenditures for any length of time, without being embarrassed, unless means were available for a rapid turnover of the capital invested in the enterprise. It is evident, therefore, that manufacturers will hesitate about entering into any export financing arrangements making them directly subject to recourse on unpaid drafts drawn on foreign dealers.

The banker, also, feels that the automobile alone is not sufficiently suitable as collateral for large financial advances and that he does not possess the necessary equipment to engage in the merchandising of auto-

mobiles in the event that a need for repossessing of cars arises. He also believes that it is more difficult to turn cars into cash than in the case of staple commodities and that he is therefore running the risk of considerable losses in resale of rejected vehicles.

Hence, a solution for international automotive financing would appear to lie in a plan that allows for these limitations of manufacturers and bankers, and still makes possible greater utilization of the collateral value of motor vehicles as a credit basis. Some



Received from the NATIONAL BANK OF COMMERCE IN NEW YORK (hereinafter termed "the Bank") the following goods, its property, specified in bill of lading dated February 10,1925 per S/S United Legion

3 Boxes Chassis Marks USA A Co. Detroit 1-3

and in consideration thereof the undersigned hereby agrees to hold said goods in trust for the Bank as the property of the Bank, with the right to sell the same for account of the Bank. The undersigned agrees in case of sale to collect and remit the proceeds of any such sale as soon as received to the Bank as security for the obligation of the undersigned to make due provision with the Bank for the payment of its acceptance on account of the undersigned, noted at the foot hereof. The undersigned further pledges to the Bank said goods and their proceeds as security for the payment of any other indebtedness of the undersigned to the Bank. The undersigned further agrees to enter said goods on its books in a separate account under the title of "TRUST ACCOUNT for National Bank of Commerce in New York". The undersigned shall have the right to manufacture and remanufacture said goods, identifying the product, if possible, but when in manufacture or remanufacture the product can no longer be identified, the undersigned agrees thereupon to keep and hold in trust for the Bank, as its property, manufactured goods of equal value with the goods originally delivered to the undersigned.

The undersigned agrees to protect and preserve unimpaired the possession and lien of the Bank in and to said property and further agrees to return said property on demand. The Bank may at any time cancel this trust and take possession of said property, in whatever condition the property may then be, or the proceeds thereof if sold, or of the manufactured goods of equal value above referred to, or the proceeds thereof, wherever the same may be found.

The undersigned agrees to keep said goods at all times fully insured against loss by fire and any other risks said goods may be subject to, at the expense of the undersigned, and on demand to deposit with the Bank the insurance policies or certificates of acceptable companies, the Bank to be designated in the policies or certificates as the assured substantially in the following form: "Assured: National Bank of Commerce in New York For Account of Whom It May Concern. Loss to be adjusted with U.S.A. Automobile Co. Detroit ...and payable to National Bank of Commerce in New York For Account of Whom It May Concern," or to furnish to the Bank other proof satisfactory to the Bank of such insurance.

If this agreement is signed by two or more parties it shall be the joint and several agreement of such parties.

Acceptance $12985.

Due in

Due in New York May 14,1925

Commercial Credit No. 2346-

Dated Mar. 15,1925

U. S. A. Automobile Co.

J. J. Paxton

Treas.

FIG. 4 TRUST RECEIPT, THE EQUIVALENT OF A CHATTEL MORTGAGE

project will probably have to be worked out, providing for co-operation all along the line.

It may require, perhaps, that the dealer abroad put up a guaranty of about 25 per cent to assure his interest in the transaction, and to serve as evidence of good faith. Stipulation might also be made that this amount be forfeited in the event of failure of the dealer to live up to his part in the transaction. Under this arrangement, the expenses in connection with the returning, or reshipment, of rejected vehicles would be amply covered.

The dealer might also be kept from having title to the vehicles until final payment is made. The party financing the transaction could assure itself ownership in such instances through receiving a trust receipt from the dealer. This document signifies, in countries where it is acceptable, that merchandise has been placed at the disposal of a firm but that actual title will not be passed until payment has been made. The trust receipt is not valid in all countries, but some means are usually found to control title to merchandise. (See Fig. 4.)

Much of the success in domestic financing is due to a co-operative arrangement between the manufacturer and the automotive financing company. Although this co-operation does not involve direct recourse to the manufacturer, there is usually what is known as a re-purchase agreement. Under it, the manufacturer may be called upon to assist in the re-merchandising of any vehicle rejected by a dealer.

Very likely a similar arrangement, with modifications to meet world needs, will sooner or later be worked out to the satisfaction of both the manufacturer and the party undertaking export financing. It may possibly take the form of re-shipments from one foreign country to another, or the vehicles may be returned to New York and applied to any outstanding export orders on the books of the manufacturer.

Up until now, it has been customary for the banker to insist on endorsement by the manufacturer on any credits extended to dealers and not involving a foreign bank directly. The suggestion has frequently been made that the bank, although operating in resales, exempt the manufacturer from recourse and charge an extra fee for this service.

The solution of this export financing problem may come only with the establishment of an international automotive financing company. The combined volume of automobile export trade seems to warrant such a step. The directors of the National Automobile Chamber of Commerce are convinced of this need and have recommended a conference with representatives of automotive financing companies in order to bring about greater enlightenment on a possible solution. If the outcome is successful and these much-needed financing facilities are made available in all important parts of the world, one of the principal obstacles to a large expansion of automotive sales abroad will have been overcome.

Practical Thrift Plans for Employees

By O. R. JOHNSON

Vice-President, National Automatic Teller Corporation

MANY facts indicate a unanimity of opinion among employers regarding the value to them of thrift promotion among their employees. The Savings Banks Association of the state of New York published in 1923,[1] a report on the attitude of employers on this question. Extracts from a few of the answers may help to convince the reader of the benefits of this work:

The man who is not worried by money troubles becomes a better worker and more satisfied.

Our thrift plan makes for better production.

Our turnover has been decreased from approximately 22 per cent to approximately 8 per cent.

Without question workers who save systematically are less liable to become radical.

There has been a large decrease in our labor turnover.

These quotations show definitely three benefits derived from the successful promotion of thrift. First, a decrease in labor turnover; second, increased production; third, increased conservatism of employees.

Industrial thrift and saving plans are not easy to classify, since employers have devised many plans to meet their varying requirements. These plans, however, fall into three general classes, as follows:

1. Cash Deposit Plans

Plans of this nature include all those in which cash deposits are made in some savings institution to the credit of individual employees, whether these savings are deducted from the pay envelope for deposit by the employer, or deposited by the employee himself under some recognized, consistent plan. The money saved is for deposit in a local bank or other form of independent savings institution.

Example A: Vermont Marble Company, Proctor, Vermont. Pay-roll deductions in even dollars are made at the order of employees for credit to their individual accounts in the bank of their selection.

Example B: New York Mills Corporation, New York Mills, New York.
Savings deposits are collected by an automatic teller installed by The Savings Bank of Utica, New York. The company has nothing whatever to do with the machine or the deposits in it, and has no expense in connection therewith.

Example C: Bellevue Stratford Hotel, Philadelphia, Pa. One of the mutual savings banks of Philadelphia sends two tellers to the hotel every pay day to accept savings deposits from those wishing to make such deposits.

[1] Association News Bulletin, June 16, 1922.

2. Stock Purchase Plans

Under these plans employees are encouraged to subscribe to certain amounts of company stock, paying for it weekly. Many companies use this plan with variations. Some offer their stock at prices below the level of the market, while others do not. Practically all specify a maximum permissible subscription, and provide for the re-purchase of the stock should the employee leave the company.

Example A: United States Steel Corporation.
The United States Steel Corporation has, since 1903, offered its employees an opportunity to subscribe for shares of its common stock at prices one or two points below the market. The permissible subscription is proportioned to earnings of the employee, and the stock is paid for through monthly pay-roll deductions.

Example B: Brooklyn Edison Company.
Employees of this company may subscribe any desired amount up to a maximum of $4000 to the Employees' Investment Fund. The money thus obtained is pooled and used for the purchase of stock, bonds, or other obligations of the Brooklyn Edison Company.

3. Profit-Sharing Plans

Under these plans a percentage of the profits of the firm, variously computed, are paid in to the employees' savings fund so that individual accounts are credited either in proportion to their length of service, their amount of voluntary savings, or a combination of both. While many companies have established the custom of distributing these profits to individual employees in cash, the practice cannot strictly be called a savings plan, since no provision is made for the saving of money, and no inducement is offered for that purpose. All that can be said about these plans, as related to our present subject, is that they have the same object in view as have thrift-promotion plans: decreased labor turnover and improved morale.

Example A: Winship, Boyt and Company, Wakefield, Mass.
Every employee in the service of this company for more than one year is given an interest in the business equal to 20 per cent of his earnings for the year plus 1 per cent for each additional year of service.

One-half of the annual profits of the company are set aside for the employees, and credited to the individual in the proportion that his annual wage bears to the total annual pay-roll. One-half of this sum is paid in cash, and the other in the form of a certificate bearing interest at the rate of 6 per cent.

Example B: Union Trust Company, Chicago, Ill.
This bank sets aside annually 5 per cent of its net earnings for distribution to the employees' savings fund, and to pay the premium on the company's group insurance policy.

4. MISCELLANEOUS PLANS

Group Insurance, Investment Certificates.
Combination Savings and Group Endowment.
Insurance, and Pension Funds.

Strictly speaking, none of these are properly classified as thrift promotion plans. However, they should be mentioned, since they are very often considered by employers to be such, and it may be of some interest and value to show later just how and where they fit into thrift promotion work.

Which Plan Is the Best?

An analysis of all the preceding plans will show that they fall broadly into two classes. In the first will be found those plans in which the employer encourages independent thrift and saving upon the part of his employees. That is, he is encouraging and assisting his employees to manage their private financial affairs in the most sensible and efficient manner, and is openly neglecting obvious direct ways of tying his employee to his pay-roll.

In the second, by far the largest class, are those plans which have for their primary and direct purpose the tying of the employee to his job by offering real financial benefits obtainable only if the employee completes a certain minimum period of service. It may be well to show by example exactly what is meant.

In that type of plan in which the employer assists the wage-earner to save money for credit to his individual, independent savings account, the benefits accruing to the employer are indirect, and in many cases untraceable. The employer simply takes for granted the general principle that the more thrifty his employees become, the more valuable they are to him, and the more likely they are to stay with him.

In the second type of plan, illustrated by both the stock purchase and the bonus and profit-sharing plans, the employer, while keeping the employees' interests at heart, has taken steps to insure direct, tangible returns to himself. Stock is sold to the employee, for instance. Here the employer benefits by the sale, but so also does the employee, for he gets this stock below market prices, and payments are arranged upon more advantageous terms than could be secured otherwise. In the bonus and profit-sharing plans the employee is usually credited with his share only on condition that he complete a certain minimum period of service, and in most cases the privilege is not even offered to employees until they have been with the company one or more years.

Which Type Is Most Used?

A study of the plans used by the majority of the larger corporations in the country shows very clearly a tendency toward the use of the second type of plan, namely, those in which direct benefits are insured to the employer. This is significant in that it indicates very clearly the relative influence, to date, of banks and employers in the thrift promotion work carried on among wage-earners. The plans most used are clearly employer-devised, since they aim so directly toward the accomplishment of his ends. It is to be regretted that banks have not done more in this thrift promotion work since they are in a better position to urge thrift upon the employee, and since they would probably be more generally successful.

Bankers have not been entirely satisfied with the plans now most in use, since no especial provision has been made for the requirements of their business. In recent years the more progressive banks in industrial communities have endeavored to correct this condition, and are now offering employers the choice of various types of plans in which the first consideration is the securing of the co-operation of the employee. These bankers recognize very clearly that a thrift plan without the employee is only a plan, very pretty on paper, no doubt, but useless from any other standpoint.

There are two outstanding defects in the type of plan which the employer has so far favored. The first has already been mentioned: The plans have been made primarily for the employer, and have, therefore, not yet given proper consideration to the requirements of the employee.

The second great defect with these plans is their undoubted flavor of paternalism. The employee, as a rule, resents any invasion of what he considers his private affairs.

Objections to the Stock Purchase Plans of Thrift-Promotion

One handicap of the stock purchase plans is that they tend to make investors, and sometimes even speculators of many who have not even a savings account.

A statement appearing in one of Babson's special bulletins last year states the case very well:

> From the industrial worker's point of view, we believe that a savings account is the first logical investment he should make with his money.
>
> . . . Mr. Clarence J. Hicks of the Standard Oil Company, speaking at the annual meeting of The Associated Industries of Massachusetts a few days ago, outlined a company stock plan which his corporation had put forward to interest their employees. As far as such plans go it was excellent; but we still maintain the position that the field of legitimate investment for the wage-earner is limited to a narrow choice of gilt-edged securities. Industrial stock is not in that category.

Bonus and profit-sharing plans cannot strictly be called thrift promotion plans, since they create no habit among employees except possibly one of hopeful expectancy. The bonus is in many cases spent weeks in advance of its recept; and, further, since the bonus received frequently fails to meet expectation, a keen feeling of disappointment, amounting almost to dissatisfaction, is as likely to be created as a feeling of gratitude and good-will.

Another general objection that can be offered against almost all the plans now in use is that they are rarely promoted with sufficient vigor to secure the co-operation of even a majority of the workers employed. Of course, most plans are started off with a great hurrah, but it is astounding how quickly the enthusiasm evaporates—and yet the executives of the company maintain a continuous air of gratification with a plan that is virtually defunct.

The perfect industrial savings plan can only be one that thoroughly meets the various requirements of the three people concerned—the banker, the employer, and the employee, particularly the employee.

The perfect industrial savings plan will have the following characteristics:

1. Safety of the funds deposited
   The wage-earner cannot afford to take risks of any kind. The money saved should be handled under regulations not less strict than those governing the operation of savings banks and institutions of that type.
2. Privacy
   If a plan is to secure the co-operation of the wage-earner, it will have to afford him complete privacy. Most working people do not care to have their employer, for instance, know what they are saving. Whether justified or not, they are very quick to suspect a relationship between knowledge of this sort and changes in wages or personnel.
3. Freedom of action
   In addition to having complete privacy, the wage-earner insists upon complete freedom of action. He must be able to save or not, as he pleases, when he pleases, and as much as he pleases.
4. Freedom from paternalism
   The term is rather a broad one, but what is meant here is the real or imagined interference of the employer in his employees' private affairs. The dangers of paternalism vary according to the type of worker. Some firms employing only female help can do things that would speedily ruin a taxicab company employing two-fisted "free born Americans".
5. Simplicity and economy of operation
   The ideal industrial savings plan must, of course, be so simply operated that no resistance will be encountered anywhere on the plea of too much work. Furthermore, it must be so economical that both the employer and the bank, and particularly the bank, can see their way clear to install and operate it.
6. Ease and convenience of saving
   This is probably the most important detail of all, since if saving is not made easy and convenient the employee will not save and the plan will not be worth installing. The fact is that the wage-earner is not saving today because it is too much trouble for him to make a deposit at the bank.
7. Flexibility
   The ideal industrial savings plan must be sufficiently flexible to be universally applicable. Many kinds of situations must be met, and the ideal plan must be ideal in the factory as well as on paper.
8. Vigorous promotion
   No plan ever ran itself. Many large advertisers have discovered to their sorrow that they did not have the grip upon their markets that they thought they had in the full flush of their advertising and sales campaigns. Thrift and the saving of money also have to be pushed continuously and vigorously; otherwise there will be a lamentable tendency for the individual savings accounts to peter out to nothing.

The employer who is seriously considering the installation of an industrial savings system among his workers should first of all make a study of the various plans available. It is very likely that he may find that no one plan is going to meet his needs, particularly if he is interested in having more than a small percentage of his employees benefit through his plan. In such case he must modify some existing plan or devise a new one.

Efficiency Report for Rating Foremen

By KENNETH MACGRATH

Monroe Calculating Machine Company

A SYSTEM of efficiency reports is used by the Monroe Calculating Machine Company for rating foremen. These reports are made up from 6 items which control the efficiency of a department, and which are assigned values totaling 100, as follows:

Operator's efficiency	50
Idle time	12½
Set up	12½
Repairs	10
Scrap	10
House service or dept. labor	5
Total	100

We find that this scheme has been a wonderful incentive to the foremen in our plant, as they know that they are being kept track of from week to week and that a poor report cannot be accepted continually, while a good one boosts them with the management.

Details of calculating the various values for compilation into the reports are explained below:

Operator Efficiency. This is arrived at by taking the hours earned in a department and dividing them by the hours worked, which gives the efficiency of the individual foreman. Maintenance of a high ratio of production, we figured, was the most important part of a foreman's duty; therefore half of the total number of efficiency points was assigned to this item. For example, if a department produces 120 per cent of standard output in a given number of hours, then the amount filled in on the chart would be 60, or half of the department efficiency.

Idle Time. This is time lost through any cause whatsoever provided the company pays the operator for it. For instance, if a department turned in a

total of 5 idle hours for the week, this time is charged for on the report at the rate of 2 points for each idle hour, which would make a debit of 10 to be deducted from 12½, leaving the amount to be credited, 2½.

Set Up. This is figured on the same basis as idle time except that a department might be allowed 2 set-up men, or 96 hours, per week. If it turns in 100 hr., it would then be charged with 4 surplus hours at the rate of 2 points for each of these hours, which would mean 8 points deducted from 12½, leaving a credit of 4½.

MONROE CALCULATING MACHINE CO.

REPAIR TICKET

PART NO.	REPAIR ORDER NO. R	AMT.
CHARGE TO DEPT. No.	DATE	

IN SPACE BELOW FILL IN OPERATIONS NECESSARY FOR REPAIR ONLY

OP. NO.	OPERATION	DEPT.	DATE	STANDARD	AM'T.
1					
2					
11					
12					

SIGN_____

DO NOT MAKE OUT SENT-AHEAD TICKETS

SEND THIS COPY ALONG WITH WORK
RETURN TO COST DEPARTMENT WHEN WORK IS FINISHED
SIGNATURE OF FOREMAN RESPONSIBLE FOR REPAIRS

FIG. 1 REPAIR TICKET

Repairs. For each dollar of repair time charged against the department, 1 point is deducted from the 10 points allowed. For example, if a department has $12 worth of repairs for one week, the figure would be arrived at by taking 12 from 10, which would be minus 2. The charging of repairs is left entirely to the discretion of the chief inspector, and is made out on the repair ticket shown in Fig. 1.

The repair ticket is self-explanatory, except the notation "Charge to Dept. No." In this space the inspection department fills in the name of the department responsible, and also that of the operator. This ticket accompanies the work to be repaired on its travels through the shop, and when the time required is filled in on the time ticket by the clerk, a notation is made next to the order number on the repair ticket, showing the department and operator to be charged. This procedure makes it an easy matter for the time department to take off the various charges.

Scrap. The charging of scrap is also left entirely to the discretion of the chief inspector. A copy of the form used is shown in Fig. 2.

Each operator is charged with all scrap (likewise repairs) made necessary through his or her carelessness. The charge is for labor only, the company taking the material loss. However, as we are operating on a standard time basis and guarantee the operator 48 hours' pay at the rate of hire, the charge for scrap or repairs can be deducted only from hours earned in excess of hours worked.

House Service. This charge covers time allowed for such work as cleaning machines, etc. Each department is allowed so much time per week for this purpose and as soon as the allotment is exceeded, each hour is charged for at the rate of 1 point per hr. That is, if a department should turn in 4 surplus hours on house service, then a deduction of 4 points from the allowed 5 would be made, leaving a balance of 1.

While this system might seem a little complicated, it really requires but a very few hours each week to keep it going. One of the efficiency reports listing and totaling the items of rating is made out for each department. All are then given to the superintendent, who distributes them personally to the foremen each week, with either compliment or criticism.

The money value of scrap (labor and material) and repairs is listed on the form, and also what are called "donations," if any are paid. This latter term is applied to a payment to a workman in excess of his actual earnings from production. For example, suppose John Jones gets $0.50 per hr. and works 48 hr., but turns out an equivalent of only 24 hours' production. His pay is $0.50 × 48 = $24, but his real earnings are only $0.50 × 24 = $12. The difference, $24 − $12 = $12, is an amount actually "donated" to him in order to give him his guaranteed minimum of pay, namely $24 per week.

This system of measuring a foreman's ability has big advantages over the old method of judging him by the amount of production he got out regardless of the cost to produce it. It would be possible to run a shop, even on a day-work basis, with high efficiency, by thus checking up the foreman, as a minimum amount of supervision over questions of quantity and quality of work and amount of miscellaneous expense is involved.

MONROE CALCULATING MACHINE COMPANY

SCRAP TICKET

No. S_____ _____ 192

PART No.		OPERATIONS COMPLETE		AMOUNT SCRAPPED	
DEPARTMENT RESPONSIBLE		OPERATOR RESPONSIBLE		OPERATION RESPONSIBLE	
ORDER No.		VALUE OF SCRAP			

ORIGINAL _____

FIG. 2 SCRAP TICKET

Unusual Manufacturing Difficulties Investigation and Cure

Methods of Selection of Material, Production, and Inspection

By C. ROY KEYS

Vice-President, Curtiss Aeroplane and Motor Company, Inc.

ONE of the airplanes manufactured in our shop carried Lieut. Maughan from New York to San Francisco between dawn and dusk without mishap. The airplane was not specially built for this trip, but was taken from stock. In developing air-

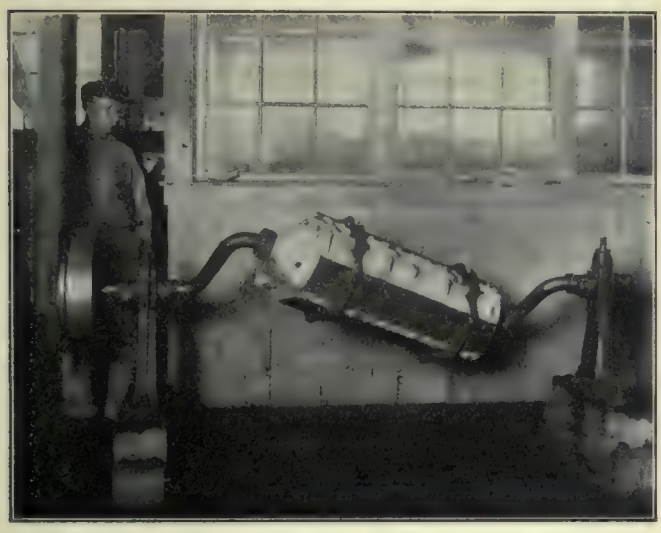


FIG. 1 A BENT SHAFT BECOMES A TUMBLING BARREL

planes to this level of reliability, we solved a good many problems which manufacturers of other products also meet.

When we set out to leave the ground for the air, we had to abandon many traditions in the shop. So we have worked out the use of some new materials, and developed a few new shop habits.

Breakage of parts bothered us, as it does every manufacturer. When a part of one of our products broke, it was not sufficient to say "Too bad" and send a new part. Breakage on an airplane might cost a man's life or the loss of the airplane through abandonment by the pilot for his parachute. So every broken part we could lay hands on was put under a rather fierce scrutiny. We asked first why it broke. Then we set out to remedy that cause. We examined parts from planes being overhauled. We put some of these parts which had been worn into our testing machines and increased the strain far beyond any that would come in practice until we broke the part, then we examined the location and character of the fracture. From every lot of new finished parts one or two were broken to test their strength in their final machined form.

All these tests of new and old parts drew one simple aggregate lesson. The most general cause of breakage is *sharp angles.* A part moving in operation becomes heated, and the expansion and contraction, as well as the mechanical strain, has a concentrated effect on sharp corners. The remedy is simple—we round off all exterior corners, and fill the interior angles with a fillet of considerable radius. The curving and filleting of corners takes very little material, but adds strength out of all proportion to the added weight.

For instance, after Lieut. Williams won the Pulitzer Race at St. Louis in October 1923 and made a world's straightaway record of 266.6 miles per hour, his engine was brought back to the factory for a precautionary overhauling. A close examination showed two tiny cracks on the outside of the weakest piston. On looking inside of the piston, we saw that these cracks corresponded to the outline of a boss which projected from the inside of the piston with a somewhat sharp circular intersection. We at once changed the design of our pistons to fill that corner with a much longer radius.

Again, a camshaft in an airplane has to be of light weight, but must not be too small in diameter. So we make it of solid steel and then gun-drill the center. We used to drill from each end toward the middle, but two such holes never meet exactly in the center so that there always is a tiny ring or edge. Our breaking tests showed that invariably the shaft broke along the demarcation of this tiny interior ring or angle. So

FIG. 2 SOUND-PROOF TEST ROOM HELPS WORK

now we drill all the way through from one end with a tool of double length. The breaking strength of the shaft has gone up remarkably.

So we began to say, "Where you have breakage, look for the square corner." Now we have not a single square-faced milling cutter in the shop. Even a so-called square-faced milling cutter had a radius of 1/64 in. at the corner, but that is much too small for our purposes and we design for fillets of much greater radii.

Lightness is another need. The principal way to secure lightness besides restricting the size of parts is by the choice of materials. We had to abandon several traditional materials and find substitutes. Our shop history shows the continual progressive substitution of new materials for old, and still newer ones for those which we thought new a year ago. Several new alloys of metals have been worked out. Light and strong aluminum alloys have been available for several years and at one time we thought aluminum was the last word in lightness. We discovered, however, that certain magnesium alloys are 40 per cent lighter than aluminum and in general somewhat stronger.

The oil pan of our 500-hp. motor, over 3 ft. long by 1 ft. wide and 1 ft. high, is now made of magnesium alloy. A man can pick up this big casting and hold it at arm's length in one hand. If the same casting were made of steel or iron, three or four men would have to tug and sweat to carry it. We now have the problem of weight and compactness so far solved that a motor weighing 680 lb. gives 600 hp., or little less than 1 hp. for every pound of the motor's weight.

We have studied whether we can make each particular part, or piece of a part, smaller, or hollow, or of a lighter alloy, old or new. It would take too much time to go into detail, but we ourselves have been astonished by what we have been able to do by diligent search for new alloys and their proper application. Our latest motors have as many as 40 different materials in the same motor.

After discovering new ideas in materials or design, we must make sure that they are carried out to the full in each routine case. Repeated inspection does a good deal. Every casting purchased for our own shop comes with a sample bar of the same material. We break the test bar to make sure that the material is inherently up to specifications. This test is made before the casting goes through the first process to be machined. Should the bar break at too low a stress, the casting is rejected, although its appearance may be that of a perfectly good casting. Most shops are content with testing one screw out of each package or hundred, or dozen. We test every screw individually, so that every screw that goes into an airplane is right. We inspect screws by a projection apparatus which throws an enlarged image of the screw thread upon a printed screen. The screen carries a diagram of a theoretically perfect thread, and the shadow of the actual screw is super-imposed upon it. The diagram of the theoretical thread is made double, one set of lines showing the maximum allowable size of the thread, and another parallel set of lines showing the minimum size allowed. If the shadow of the screw thrown upon the screen does not fall completely between these two lines, the screw is rejected. It does not take long to make this test.

These tests insure that the rapid vibrations in an airplane do not loosen its parts. The precautions seem costly, but they are a great economy in that they fulfill their object. They become less costly as fast as we reduce them to a routine. In fact, the sales price of one of the airplanes which carried Lieut. Maughan across the country is only about $19,000, which compares favorably with the cost of automobiles in their pioneer stage.

Extra precautions are a good investment even in some of the simpler processes. Sand blasts were formerly used for cleaning the insides of cylinder cases and other castings. It was discovered that some of the sand stuck to the inside of the casting and caused abrasion when the finished engine was operating. So we had to have a substitute for sand blasting. A simple home-made machine solved the problem. A piece of line shafting was bent in two places (see Fig. 1). On this oblique portion of the shaft two cylinder castings are bolted face to face, after each is filled with steel shot. Then the pulley at the end of the crooked shaft is driven from a line shaft. The two castings act as their own tumbling barrels. Shallower castings are treated by shot in a different machine which shakes them up and down. This process is much more costly than sand blasting, but to us it is economical because no particle of the cleanser clings to the finished product.

Each finished airplane motor is run into a final test room, and set up on a test block which is equipped with instruments to measure the horsepower, the gas consumption and other factors of operation. Gasoline is weighed before being fed into the motor. Then the motor is started and run for varying periods, under exactly the same conditions that would obtain in the air. The exhaust from the motor on the test block makes the same loud noise in the small room that it will finally make in the air above a city. Unless this were insulated, it would be scarcely possible to work in the adjoining shop. So the walls of the test room are of double wood construction. The doors are also double, so that each door, when standing open, seems to be a foot thick, like the door of a butcher's ice room insulated against heat instead of noise (see Fig. 2).

If the test is satisfactory, the motor is taken off the block and entirely dis-assembled so that each part can be examined for signs of wear. If any part shows appreciable wear, it is rejected, another part put in, and the test repeated until a satisfactory result is obtained. Then the motor is re-assembled, numbered, given a final running test, and is ready for assembling into the plane.

All these improvements and precautions in materials, design and method have taught us a good deal about economy, quality, and dependability. We have saved men's lives and are increasing the reliability of airplanes to the point where we can see the likelihood of failure from the breakage of mechanical parts of the engines or structure diminishing to the vanishing point. As evidence of that, note the reliability of the air mail service.

Training the Planning Staff

Methods Used by Canadian Consolidated Rubber Company

By DONALD ROSS-ROSS

Mechanical Engineer

IN many instances the executives of large manufacturing concerns come to the decision that production can be put on a more efficient basis by the organization of a planning or industrial engineering department, and having adopted this idea the next big step is the organizing of the new department upon fundamentally sound and sane lines.

If this pioneer work is left to some official whose knowledge of the subject is negligible, the foundation of the department will be built on sand and in one or two years the whole structure will totter to a discreditable end. Instances like this are apt to prejudice the executives forever against the planning department, unless they realize the folly of the ignorant, slipshod organization that was formed, and the possibility of forming a thoroughly efficient one in a second attempt.

Types of Planning Department

The second class of planning department is one built up from the experience of another concern with which it is affiliated or has allied interests. Very often a man that has shown some ability in the manufacturing end of the business is sent over to receive training in this other plant, and on completing his period of training is given the task of training others selected from his own factory office staff or from applicants for the job.

A planning department so modeled will drift on for a number of years, gradually sinking into a rut of routine work from which it never again emerges, until bit by bit its members are given new appointments, are never replaced, and at last the department loses its identity. This is invariably due to lack of technical industrial training, depth of vision, and versatility of mind, by the head of the planning department. The selection of a suitable man for this job is therefore of paramount importance.

This man should possess an excellent technical training preferably in Mechanical Engineering; a number of years of industrial and planning experience in various lines of industry so that his ideas may be of the broadest; an ingenious and inventive mind; tact, and a charm of manner. Above all, he must be a good mixer among those employees with whom he has to work so that labor troubles, which are bound to arise, can be minimized.

Having selected the right man for the job, the organization of the department and its future destinies can well be left in his hands. From his knowledge he will draw up his proposed organization on paper; planning for each of the functional appointments that he intends making in the future. It is not necessary to have any of these men experienced in planning work, as a thorough course of training conducted by himself will be far more beneficial, since then the methods of all will be uniform.

Fig. 1 shows a line-up for a strongly organized department, and indicates the general educational requirements for the various members. However, the training for all should be nearly identical and the work for some months after the training period is com-

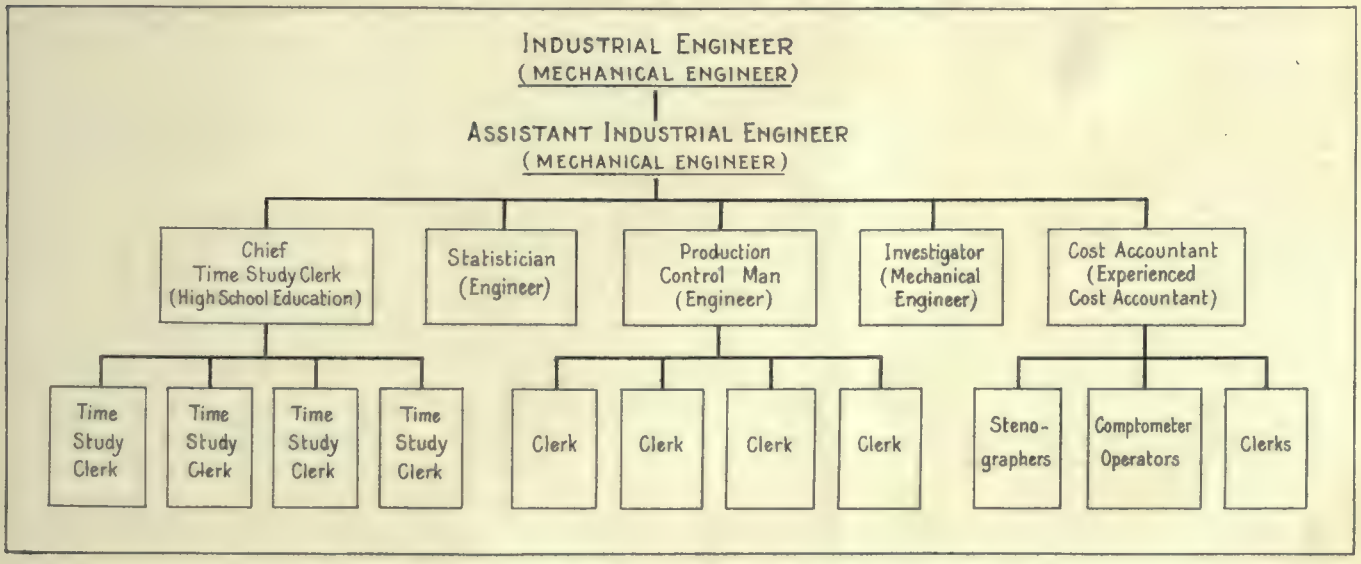


FIG. 1 ORGANIZATION CHART FOR TYPICAL PLANNING DEPARTMENT

pleted should be confined to general time-study work, so that not only a thorough grounding in this important item of the work will be gained, but also an intimate knowledge into the various manufacturing processes.

It should be noted that in the organization chart, Fig. 1, the cost office will eventually lose its own identity and be merged into the planning department, and it is therefore desirable to take the cost accountant, when possible, into the training school. On the other hand, the production control clerk will assume control of both the order and production departments and embody them in the general scheme of production control. There is no call for this man to be a member of either of these existing departments, but preferably he should be a young man with engineering training.

The Planning School

An excellent method is to start all the men that have been selected for the department in a factory training course of six weeks or so, working the full worker's day, each man being placed a few days in each of the several manufacturing departments of the factory. This gives the men a general knowledge, which is of great assistance to their work in the school. A report from each man should be handed in for each department in which he works.

The men that undergo this and subsequent training are, according to Fig. 1, the assistant industrial engineer, all the time-study men, and the chief time-study clerk, the statistician, the investigator, and the cost accountant, and, possibly, the production clerks.

○ ASSIGNMENT CARD ○

ASSIGNMENT *Job Analysis of Machine Shop*
ASSIGNED TO *James Bradley*
DATE TO COMMENCE *January 15th 1923*
DATE TO COMPLETE *January 17th 1923*
DATE COMPLETED
GENERAL FOREMAN *John Smith*

FIG. 2 SAMPLE JOB ASSIGNMENT CARD

During this preliminary training, the industrial engineer has time to prepare a schedule of work for the students. One of the most satisfactory ways is to list each job on assignment cards, Fig. 2, and hang these cards on a schedule board. The vertical rows constitute the assignments for each student. The top horizontal row indicates the jobs "in process;" the middle row the "work pending;" and the bottom row all the remaining assignments of the course, the last one being innermost. The student on completing an assignment is required to take off the card for that job, fill in the "date completed," and attach it to his report when handing it in. The card on the "work pending" row is then moved up and also the top card on the bottom row. Such a schedule arrangement permits the student to see exactly what is before him and what time is allotted to each job. (See Fig. 3).

The first step in the actual instructional work is the teaching of the slide rule to those not versed in its use. A good week's drilling in its operation should be sufficient.

The students taking this class of instruction are each given a sheet of problems similar to those which have just been demonstrated to them by the industrial engineer, and are required to work them out and hand them in. Then another class of problems is tackled, and so on until the whole ground is covered.

The second step is the job analysis. This serves to train the student's mind to assimilate minute details about the department on which he is writing his analysis. He is given a form, Fig. 4, which gives the chief

FIG. 3 SCHEDULE BOARD FOR USE WITH ASSIGNMENT CARDS

headings of the analysis. The smallest omission on his part should be brought to his attention. This part of the training is mostly psychological, but gives the student an intimate knowledge of the various factory departments which is of inestimable value to him in his future work.

In certain manufacturing departments where the processes are numerous and complicated, and there is a considerable amount of equipment, an analysis of from 40 to 50 written pages, letter-head size, is by no means uncommon.

Following the job analysis comes the routing analysis, Fig. 5, which deals solely with the movement of material and parts to, through, and from the department under consideration.

A floor plan of the present and proposed layout with the movement of the material or machine parts indicated by different colored lines with arrowheads for direction, when accompanying such an analysis, assists the student to describe the routing condition more fully, and helps the instructor to follow the train of thought.

The next step is an equipment layout analysis. It is hard to supply the students with any set form to follow as in the previous analysis and he is, therefore, left to his own initiative in this case. However, his analysis should embody the most salient parts of the department in which he is working with special reference to the layout of equipment; its accessibility for

JOB ANALYSIS

A. *Object*

B. *Location*

C. *Personnel*
1. Number. 2. Position of each operator.
3. Method of wage payment.

D. *Equipment*
1. Machines.
2. Tools.
3. Transportation facilities.
4. Miscellaneous.
5. Floor plan.

E. *Materials.*

F. *Relations to Other Processes.*
1. Processes preceding.
2. Processes following.
3. Routing methods.

G. *Process.*
A complete and detailed account of every motion made, etc.

H. *Local Conditions.*
1. Lighting.
2. Ventilating.
3. Heating.
4. Safety devices.
5. Sanitation.
6. Fire protection.

I. *Lost Motion and Interference.*

J. *Recommendations.*

FIG. 4 JOB ANALYSIS SHEET

ROUTING ANALYSIS

A. *Object.*

B. *Equipment Layout.* With reference to the movement of material through the department.

C. *Proposed Layout.* For greater efficiency, showing the proposed routing and giving the advantage of such a change.

D. *Equipment.* Any new equipment that is required for the proposed layout must be described.

FIG. 5 ROUTING ANALYSIS SHEET

maximum production and minimum labor cost; its lighting facilities; and its place in the general routing plan. He should be required to describe the equipment, make a floor plan, and give a re-distribution of equipment together with a new floor plan, showing his ideas for increasing the efficiency in the department.

A departure is now made from analysis, and the students in a group are given their first instruction in time-study in the classroom or office in which they work. It is necessary first to explain how to use a decimal stop-watch. The most suitable form of watch which the writer has found is the one in which the large dial is divided into 100 parts, making one minute, while the small dial (corresponding to a second dial on an ordinary watch) indicates the minutes elapsed. Also, instead of having only the stem control—one press to start the watch going, the second to stop it, and the third to send it back to zero—it is much more satisfactory to have a sliding piece on the side of the watch to stop and start it, and the pressing of the stem to start it back to zero. This permits a study being stopped at any point and then started again when it is desired to continue taking times.

Method of Instruction

A very simple and unique method of giving the first instruction is to use a pack of ordinary playing cards. With the students lined up in front of his desk, their boards properly held, the instructor explains that he will shuffle, fan, cut, lay, and gather up, each of which they are to take as an "element" of operation to be denoted by the letters a, b, c, d, etc. To make it as easy as possible the instructor should bring the cards down with a rap on the desk, a signal for all watches to be started. After shuffling, etc., a light rap should also be made in order that the students may know when to take their readings.

It is obvious that the knock removes the necessity for watching the instructor, but it is desirable to do so until the men become able to read the watch quickly. Gradually, the raps should be made lighter and lighter, until the completion of the so-called "element" is indicated only by bringing the pack to a vertical position resting on the desk. This makes the students follow the motions with their eyes while taking the time readings and recording them on the time-study sheet. (Fig. 6).

To follow the progress of the men, at the end of each exercise one should be made to read his elements and readings, and the others should follow him and check up any discrepancies. As soon as sufficient self-confidence has been gained, they should be instructed in

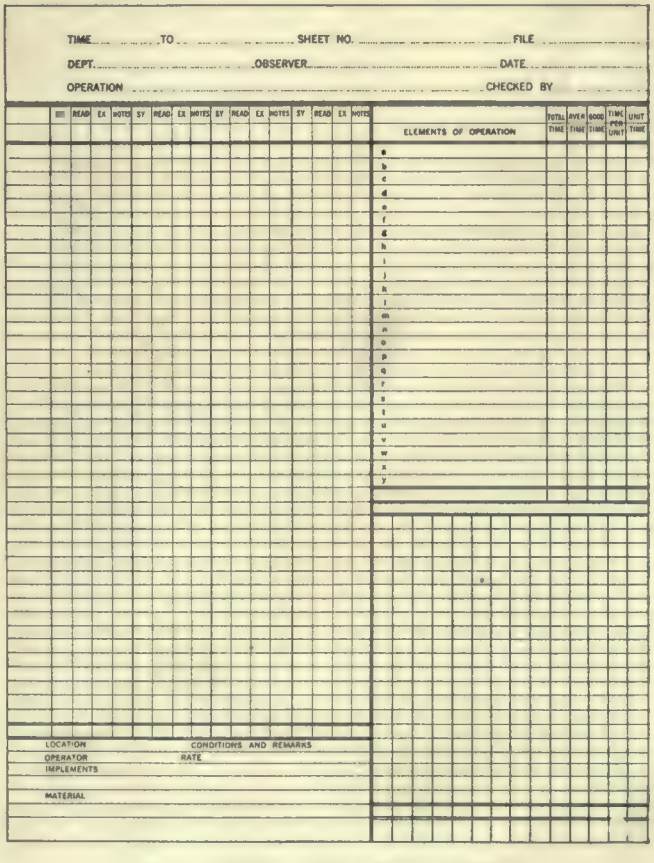


FIG. 6 TYPICAL TIME-STUDY SHEET

the actual use of time-study sheets, a sample of one very convenient form being shown in Fig. 6.

Each student should be started in the factory on some very easy operation, the time-study to be completely worked up and a piece rate set on the operation. Five or six time-studies will be found sufficient in most cases.

Time-study and motion-study are excellent things to include in the course. They require three or four operators doing identically the same operation, with the same elements used by each. To save time, a form should be used, Fig. 7, listing the elements.

ELEMENT 2. POSITION OF LAST IN DRAWING LINING OVER LAST	OPERATOR A.	OPERATOR B.	OPERATOR C.
A. Bottom of last perpendicular and away, heel down			
B. Bottom of last horizontal, heel towards maker			
C. Bottom of last horizontal on table, heel to right			
D. Bottom of last horizontal on table, heel to left			

FIG. 7 FORM LISTING ELEMENTS FOR TIME-STUDY AND MOTION-STUDY

All that is necessary is to put a check in the operator's column opposite the particular method adopted by him, whether A, B, C, or D, and so on for all elements and each operator. The time intervals are then found by time-study for each element and for each operator. For three or four operators of equal skill, it will be found that, for certain elements, one will outdo the others. The motions belonging to these faster times are considered correct, and the student will then build up a complete list of "correct" elements for the operation from his findings.

Having reached this point, it is hardly necessary to take the students further, with the exception, possibly, of the chief time-study clerk. These men can best be started on their actual work.

For the remainder, time can well be spent on written standard practice, graphic production control, charting, statistics in their relation to production, the elements of cost accounting, factory organization, etc. The only guide the instructor has as to how deeply any or all of these important items should be gone into is his preconceived plan of organization of his own department as it will be when finally completed.

Final Organization

As has already been stated, it is advisable to have all the erstwhile students take time-studies and set piece rates for some time after the completion of their course. Such an arrangement allows the industrial engineer time to gather together the loose ends and prepare the road for each of his functionaries.

Gradually a selection of men for the various positions can be made; and the necessary staff of clerks, stenographers, and comptometer operators is then placed under their direction. It will be found by experience that an organization along the lines given in Fig. 1, is very complete without being cumbersome, and adds greatly to the scope and effectiveness of the industrial engineer and the value of the department to the plant as a whole.

Production Tickets Co-ordinate Departments

IN tire building, the necessary strips of fabric and rubber for one tire are cut and collected between the leaves of a cloth book for handing to the tire builder. One book holds the exact amount of material for one tire.

Former Production Methods

The two jobs—measuring the material and building tires from it—used to be scheduled somewhat independently in one manufacturing company. If the material gatherers got ahead of the tire builders in their work, extensive racks between the two departments were expected to take care of the extra material until the tire builders caught up.

The cutters would often be given a big batch of one kind and size of tire to prepare. This batch might be bigger than could be assimilated by the tire builders for several days. Yet the racks had to be big enough to hold all the surplus of all kinds. Meanwhile, there might be a deficiency of material for some other kind of tire.

Finally the company borrowed for its rubber-tire making a method current in rubber-shoe making. It was decided to make up the books by ticket just as it is done in shoe making. That is, the quantities of tires of the different sizes which are to be made in the tire building department on each day are listed on a ticket. A copy of this ticket goes to the material bench. Only those sizes are measured and cut which are on the building ticket for the next half day. That is, the material is gathered not according to the independent exigencies of two jobs but in strict accordance with the immediate future needs of the building department.

Results of New Plan

As a physical proof of the increased co-ordination, the number of racks necessary to take up slack and extra supply between these two jobs was reduced from 17 racks to 5.

This sets free a corresponding amount of space and it ties up much less material. It also makes lighting conditions very much better in the room which houses the two departments, as there are not so many racks to obstruct light between them.

Storing Coal Without Danger of Spontaneous Combustion

By JAS. R. McCAUSLAND

Assistant Superintendent, Coal Bureau, The Philadelphia Electric Company

THE tendency of bituminous coal to develop spontaneous fires when stored in considerable quantities has long presented a serious problem to all concerns that find such storage necessary. Particularly at this time, with the Coal Report of the American Engineering Council Committee recommending more uniform purchases with consequent increase in storage facilities required, the problem of storing coal without loss from fires is very important.

The Philadelphia Electric Company has developed a storage method that has given excellent results. At the present time they have in storage over 225,000 tons of coal, all of which has been stored for over a year. During the past year not a single fire occurred in the pile. In addition to this, the storage piles range from 20 to 30 ft. in height and approximately 90 ft. across the base. Since, with ordinary storage methods, piles 10 ft. high have been about the practical limit for safety, it is evident that by their method the Philadelphia Electric Company has increased the capacity of their storage space by at least a third, while eliminating loss from fire.

The storage method is quite simple. Coal is spread rather evenly in layers 3 or 4 ft. thick. Each layer is packed down by a heavy drag (see Fig. 1) or roller drawn by a caterpillar-tread tractor. This operation compresses the coal to such an extent that each layer

FIG. 1 TRACTOR-DRAWN DRAG PACKING COAL

is effectually sealed against the entrance and circulation of air, and spontaneous combustion becomes practically impossible.

Locomotive cranes have been generally used to spread the coal over the pile. Where these were not available, motor trucks have been used (see Fig. 2). To reduce pulverization of the coal by passage of the trucks, the drive over which the truck reaches the dumping point is planked.

Comparative tests have been made in which a quantity of coal has been stored by this method at the same time a similar quantity was stored alongside using the old method of loose storage. Within four months

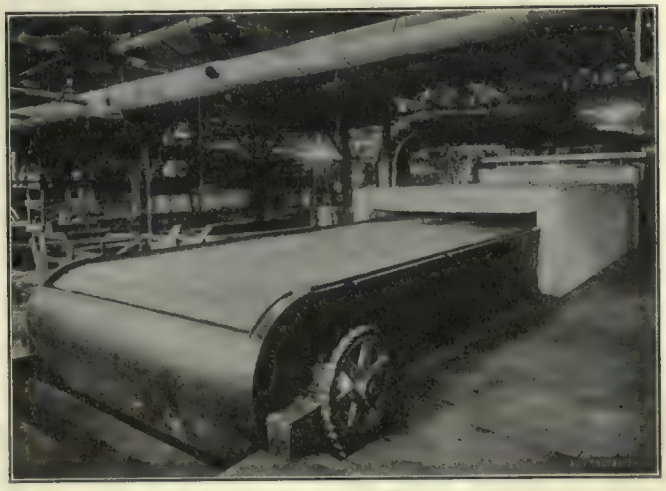
FIG. 2 UNLOADING COAL FROM MOTOR TRUCKS

the pile stored by the tractor method was perfectly cold while the other pile was very hot and had actually caught fire in several places.

Temperature Control in Glass Manufacture

IN the manufacture of glass bottles accurate control of temperature is necessary to secure uniformly good product. In the annealing cycle, especially, close control within narrow limits permitting the glass to cool uniformly and at a definite rate, is essential. Otherwise strains are set up in the glass, making it break easily.

Some time ago the Illinois Pacific Glass Company installed an electrically heated glass lehr as an experiment. This installation had a connected load of 125 kw. Various temperature zones are located in the lehr and individual automatic temperature control in-



ELECTRICALLY HEATED GLASS LEHR

struments keep temperatures constant. Glass at a red heat is placed on a conveyor, is carried through a heating zone to equalize the temperature of the glass and then passes into lower temperature zones for cooling.

This equipment proved to be so successful that other electrical lehrs have been installed. Sizes have been increased so that the latest order placed with the General Electric Company calls for lehrs with a connected load of 470 kw. Operating costs of the electrical equipment have been found to compare favorably with those of other types of equipment. Maintenance costs are negligible, the upkeep of the first experimental lehr costing but $50 for 3½ years.

Electric Heat in Battery Manufacture

By P. E. NORRIS

Production Engineer, Westinghouse Union Battery Co.

SEVERAL interesting production problems arising from the manufacture of storage batteries have been solved by the use of electric heat in the factories of Westinghouse Union Battery Company.

The sealing compound used to seal the covers into the cells of automotive batteries has always been a serious problem. For best working conditions, this compound should be kept at a constant temperature. Its heat conductivity is so low that a hot plate under the compound kettle is very unsatisfactory, and the compound is so inflammable that the use of an open flame is dangerous.

The problem was solved by using electric heat. Westinghouse space heaters were clamped solidly against the sides and bottom of the compound tanks and were

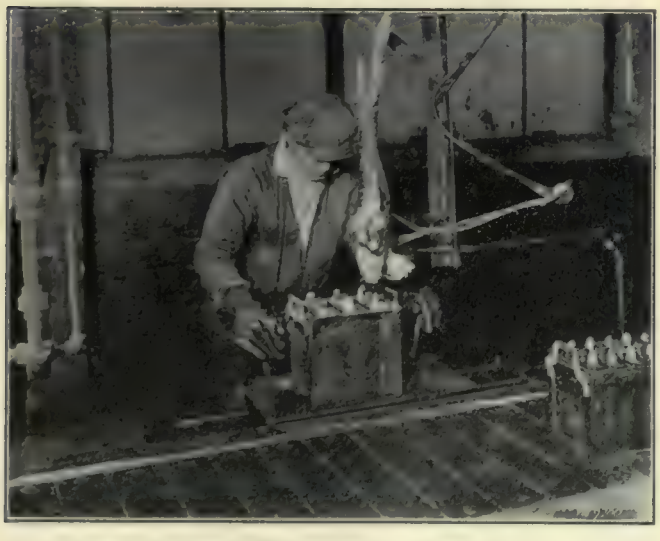


FIG. 1 ELECTRIC HEATER FOR SEALING COMPOUND

then covered with sheet asbestos. The pipe leading from the tank to the sealing machine was heated by passing through it a low-voltage, high-amperage current. Near the nozzle of the pipe there is a thermocouple that actuates a relay which in turn opens or closes the circuit leading to both the space heaters and feed pipe and keeps the temperature well within the desired limits. Fig. 1 shows the electrically heated pipe through which compound flows from the tank to the battery.

The soft metal storage battery grids have a very light cross-section and are cast in metal molds. Unless the molds are at exactly the right temperature, it is impossible to get good production of perfect grids. Heretofore an open flame was used to heat the molds but proved unsatisfactory because of difficulty of regulating the temperature and because of its danger.

Electric space heaters were clamped on each side as shown in Fig. 2. They were connected in opposite pairs so the operator could control the temperature of any part of the mold by means of a switch. Pilot lights were used to indicate which heaters were working. This installation enabled the operator to control

FIG. 2 HEATING BATTERY GRID MOLDS

mold temperatures accurately, and was a considerable aid to good production.

In one department long strings or "worms" of sealing compound, about ¼ in. square are used. They are extruded from a press and used cold. The press could not work the cold compound perfectly so a couple of space heaters were clamped to it. They warm the press just enough to make the compound flow out in the proper condition.

In addition to these special installations we use electrically heated lead pots for melting small quantities of lead, solder, etc. We have found electric heat very satisfactory because of its safety, flexibility, and ease of control.

Unique Electric Oven

By C. H. STEVENSON

Commonwealth Edison Co.

A RATHER unusual application of electric heat has been made in the Chicago plant of the General Fireproofing Company. A short time ago the company required an oven in which to bake japan on refinished parts of steel desks.

FIG. 1 ELECTRIC OVEN SHOWING CONNECTIONS

Among the products of the company was a fireproof vault, insulated with 4 in. of amorphous silicate and asbestos fiber, and designed to hold a temperature of less than 250 deg. fahr. on the inside for 2 hr. while subject to a temperature of 1800 to 2000 deg. fahr. on the outside. The company reasoned that this vault should be as able to retain heat as to repel it, so two 2½ kw. Westinghouse oven heaters were installed at the bottom of one of their large-sized vaults. Three holes were drilled on each side at the bottom and a vent pipe connected at the top for ventilation. A controlling thermometer and a contractor panel were installed and the oven was complete.

Because the transformed vault was originally intended for use in an office, it presents a much better

FIG. 2 INTERIOR VIEW OF OVEN

appearance than usual oven installations. The inside and outside are finished glossy dark green, japan trimmed with light green, and metallic parts are nickel plated.

The oven is 44 in. wide, 75 in. high and 35 in. deep. It operates about 8 hr. each day for 20 days a month at a current cost of about $15 with electricity at 3 cents per kw-hr. Fig. 1 shows the oven with its electrical connections. Fig. 2 is an interior view showing the heating units at the bottom.

Sales District Rating Scale

By WARREN HAINSWORTH

SALES executives seek a practical rating scale for application to their various districts, territories, or other distribution divisions.

Forms given below illustrate a simple plan for this purpose.

Six comparable sales districts yielded results per thousand population in a given period as shown in Table 1.

TABLE 1. PER CAPITA SALES—EASTERN DISTRICTS—FEBRUARY 1925

The A. B. C. Company

District	Sales Dollars	Line "A" Boxes	Line "B" Cases	Line "C" Pounds	Sales Dollars District Cost
I	$300	90	20	185	$28
II	261	84	18	144	24
III	180	77	15	70	21
IV	282	81	19	240	30
V	165	72	12	65	12
VI	225	77	13	170	15

The principle of rating is to be that of comparing each yield with the highest record in the group—that highest record being considered 100 points.

Accordingly, the yield figures are rearranged to list the districts in their order or rank, expressed in percentage of highest yield, Table 2.

TABLE 2. DISTRICT RATINGS BY LINES

Highest District = 100

Total Dollars	Line "A"	Line "B"	Line "C"	Sales Dollars District Cost	All Factors
I....$100	I...100	I...100	IV..100	IV....$100	IV...480
IV.... 94	II.. 93	IV.. 96	I... 77	I.... 93	I....470
II.... 87	IV.. 90	II.. 90	VI.. 71	II.... 80	II...410
VI.... 75	VI.. 85	III. 75	II.. 60	III.... 70	VI...346
III.... 60	III. 84	VI.. 65	III. 29	VI.... 50	III..318
V.... 55	V... 80	V... 60	V... 27	V.... 40	V....262
Attained....$471	532	486	364	$433	2286
Maxima....$600	600	600	600	$600	3000
Unattained..$129	68	114	236	$167	714

This table discloses clearly the relative standing of the various districts, in dollars per capita sales, in unit per capita sales, and in dollar sales per dollar of district cost.

Summary totals in right-hand column and at bottom of schedule furnish a numerical rating for each district, for each product line, and for the group of districts as a whole.

The "Unattained" balances, charted over a number of periods, reveal graphically the trends toward even-spread distribution per capita.

This rating plan is adaptable to any length time period, any number of comparable sales areas, any number of product lines; affords an excellent basis for policies of advertising and other forms of promotion; and is serviceable in quota and remuneration problems.

THE EDITORS' PAGE

Our New Home

ON March 30th MANAGEMENT AND ADMINISTRATION moved its editorial and business offices to 15 East 26th Street, New York. Please address all correspondence to this new address. Readers and other friends who pay us personal visits will receive a cordial welcome at all times.

The Source of Profit

MR. FRANKLIN in the final paper of his presentation of the work of the industrial executive to MANAGEMENT AND ADMINISTRATION readers very properly and happily takes up the subject of manufacturing profit. His discussion is exceptionally clear and forceful. He brushes aside all academic argument as to which should be the primary consideration, profit or service, by linking these factors in their true relationship.

> Every industrial executive and every owner in an industrial enterprise, whether in whole or in part, strives for and desires a profit. This is the essential reason for ownership. But ownership is no longer, if it ever was, a warrant for profit, for profit must come from the public, and can come from nowhere else. The public is only willing to pay a profit for service, and, with the wider spread of industry, for the best service; therefore, essentially and fundamentally, industry is a service.

Here the thought that ownership is a warrant for profit is condemned; industry is declared to be service; profit can only come from the public as a reward for service rendered. No one, not even the churchmen, has placed these relationships on a higher plane, though others have stated and supported the essentials. Bishop Francis J. McConnell wrote: "As to profits [in industry] we must recognize under the present system legitimate taking of risk for the sake of industrial expansion. The man who takes the risk is entitled to reward. But there is too much profit that represents no service whatever."

Turning to the management aspect of industry as a service, management is the means through which an industrial enterprise can render essential service, deserve a profit from its operation, and secure that profit as a reward paid by the public; that is management on its highest plane, and it is worthy of the best efforts of any man. Quoting again from Bishop McConnell: "The inventor, the scientist, the industrial organizer, all can help on the coming of the Kingdom of God."

Mr. Franklin does not stop with the source and justification of profit. He tells what the industrial executive, the management, must do so that an industrial enterprise may deserve a profit, emphasizing that right answers must be had to many questions concerning the quantity and quality of product, manufacturing machinery and equipment, production processes and operations, material and labor, selling price and market. In a sentence: the producer of a manufacturing profit is good management devoted to essential service.

Pennsylvania Giant Power Survey

ON the 24th of May, 1923, Governor Pinchot approved the act creating the Pennsylvania Giant Power Survey Board. In February 1925, 21 months later, this board completed its work on a report stating its findings.

For intensive water power development the board recommends "a statute to put beyond a doubt the legality of the merger and consolidation of hydro-electric and steam-electric generating companies, under proper restrictions."

The essentials in the generation of electricity by steam are listed as: Adequate public agencies to guard investors' rights, mass production, mass transportation, effective and simple regulation, and justly regulated interchange of power with other states, none of which are provided by the present state law.

The proposal for carrying out these plans centers around the creation of a permanent Giant Power Board in the Department of Forests and Waters to direct the application of coal deposits to state-wide electric service through a competent technical staff.

The goal to be reached is the transmission of current in large volumes over great distances without loss; that is, over a network of 220,000 volt lines. Power will thus be generated under methods accomplishing the utmost conservation of natural resources, and at the same time be cheap enough to bring its advantages within reach of every industry, home and farm.

Cheap Power in Spite of High Costs

THE industrial power plant has been placed in a rather difficult situation during the last few years, and one from which there is no direct escape. The cost of coal has practically doubled, and labor costs in the power house, as elsewhere in the plant, are at least twice what they were 10 years ago.

But labor-saving equipment has come to the rescue of high labor costs by reducing them even below the point where they were in the golden days, before the war. Power plant instruments and improved auxiliaries have attacked the problem of coal costs, and while they have not reduced the price per ton, they have enabled the fireman to operate his boilers more efficiently than ever before, even when coal was cheap.

Good management and a complete study of the power situation, of course, have been necessary to get this coal handling and power production equipment

installed and operating. Other direct savings are also the result of sound engineering investigation and competent management. But the combination of equipment and intelligence has worked wonders in many cases.

On page 325 of this issue, C. E. Killinger, Vice-President and General Manager of the Willys-Morrow Company, presents information showing how the power house in this plant has saved annually $12,900 by the installation of coal handling equipment; $12,400 by the utilization of exhaust steam formerly discharged to the atmosphere; over $38,400 through better operation of the boiler-room, utilizing power instruments and some new equipment; and $3500 through more efficient operation of an air compressor unit—or a total of over $67,200.

Experiences like these show what can be done. They should be an inspiration to every plant manager who knows that he has not licked his power problem.

Science in Invention

DARIUS GREEN of flying machine fame has long been regarded by many otherwise intelligent persons as representative of that class of individuals commonly known as "inventors." Inventors are considered queer. They have always had such peculiar ideas—that they could use a waterfall to run machinery miles away; that they could fly through the air; that they could carry on conversation over miles of intervening space; and other beliefs just as extravagant.

That these and countless other "impossible" things have been accomplished in no wise deters the scoffers from belittling each new announcement of future discoveries. Why? The basis of this skepticism seems to lie in the fact that few persons realize that practically all important contributions to human knowledge have been, and will continue to be, made by scientists, by individuals who spend years, perhaps a lifetime, in the study of one phenomenon—by persons who are so immersed in their study that every event, no matter how trivial in appearance, may assume enormous proportions, viewed in the light of their specialized intelligence.

The discovery which has led directly to the electric motor, the telephone and telegraph, and other beneficial results of electricity came about through an occurrence which the uninformed call luck. In 1820, the Danish philosopher, Oersted, discovered that an electric current has the power of deflecting a compass needle. A chance observation, to be sure, and one which has been made many times since, but it needed profound interest, scientific knowledge, and a questioning attitude toward all phenomena, to detect in this discovery the relation between electricity and magnetism and so lead to the great electrical developments of the present.

Rare, indeed, is the important discovery that is made through happy chance. Inventors are among the most hard-working and self-effacing mortals. For every scientist who makes a discovery of enough general interest to bring his name before the public, there are countless others who spend their lives in scientific labor, which is fruitless in so far as money or fame is concerned, but which adds links to the chain of evidence along some new line of scientific exploration.

Information and Readers

THE thought is frequently expressed in one way or another that "the cheapest thing in the world is information." Properly rounded out as an idea, we should say "information is the cheapest thing in the world to buy, the most valuable to use."

Just take the magazine in which these comments are printed as an illustration. The cost of this copy to you, the reader, is a little more than one cent per article, or one-half cent per editorial page. Either sum is a trifle compared with the possible saving, improvement, advantage, or way-out of an operating difficulty, which some one of the printed articles may suggest. That such definite practical assistance is rendered by the magazine is amply proved by correspondence reaching the editors.

The possibilities of finding usable information, though its cost is so little, are greatly increased by the authoritative origin of the articles and papers. Glance at the contributors to this issue and note the positions of president, vice-president, general manager, production manager, engineer and others! These are men who know and write from matured, successful experience. In 1924 the authors of the major articles in MANAGEMENT AND ADMINISTRATION held these positions:

	Per Cent of Total
General executives	23
Presidents, vice-presidents, general managers, treasurers	
Operating executives	42
Works managers, production managers, superintendents, general foremen, engineers	
Sub-executives	2
Assistants to president	
Office executives	19
Sales managers, office managers, advertising managers, controllers, credit managers	
Miscellaneous	14
Government officials, educators, editors	
Total	100

That is, 86 per cent of this group of authors were responsible executives in charge of the operation of manufacturing enterprises. Those represented in the other 14 per cent had an intimate contact with industry, though not in an executive capacity.

The earnest desire of MANAGEMENT AND ADMINISTRATION to extend the service which is made possible by its editorial pages leads to this request, without, however, wishing to burden the present readers of the magazine. Without doubt, everyone who receives the magazine has, among his acquaintances, executives who might find its pages valuable and useful, but who do not receive it. We therefore shall be grateful to those readers who will send names of others to whom we can present the possibilities of the magazine, believing that in so doing a double service will be done—to the prospect and to us.

INDUSTRIAL EQUIPMENT
NEWS FOR THE MANAGEMENT

This department is conducted to give our readers essential facts regarding items of industrial equipment recently placed on the market, that may be used to increase production or lower costs. The editors will be glad to furnish additional information about any item. All information given is obtained from reputable manufacturers, and MANAGEMENT AND ADMINISTRATION accepts it as reliable.

Transformer Load Indicator

A DEVICE for indicating the load on distribution transformers has been developed by the General Electric Company and is called Type A thermotel. It consists essentially of two thermometers connected in series. One is actuated by the transformer's top oil; the other, located in the external case, is actuated by the ambient temperature and modifies the reading of the first. The composite reading is given in terms of "per cent equivalent load." Calibrated from 50 to 125 per cent equivalent load, a semaphore swings into view when the instrument registers more than 100 per cent. The device is very easy to install and is suitable for a wide range of 60-cycle, pole-type, distribution transformers.

TRANSFORMER LOAD INDICATOR

Coal Crusher

FOR the preparation of fine and uniform-sized coal for use with stokers, for crushing coal for pulverizers, gas plant use, etc., Pennsylvania Crusher Company has developed the Armorframe Single Roll Crusher.

Coal is fed to the crusher in any quantity desired. The rotating toothed wheel shown in Fig. 1 draws the coal into the tapered opening between the roll and breaker plates, crushes it to the desired size and discharges it below to a belt, elevator, or bunkers. Heavy suspension springs support the breaker plate and yield for the passage of tramp iron or other uncrushable materials. The side frames are formed of 30 in. I-beams. Cross members are heavy channel and angle plate. Bearing housings are electric cast steel, shouldered and hot riveted to frame. Breaker plate tip is reversible and renewable.

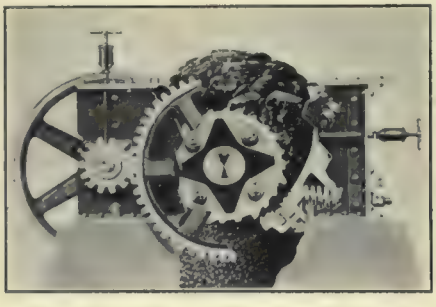


FIG. 1 PHANTOM VIEW OF CRUSHER

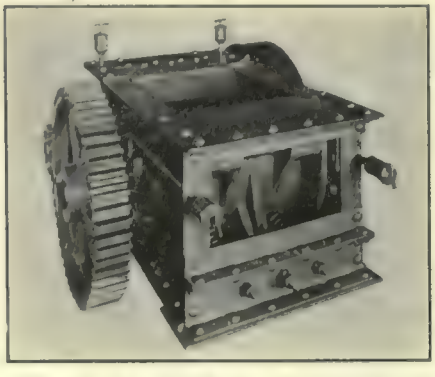
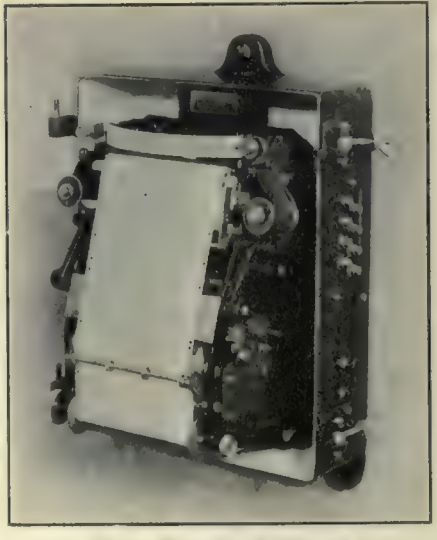


FIG. 2 SINGLE ROLL CRUSHER

The entire equipment is designed to stand up under hard and abusive use with little attention except periodic lubrication. Crushers can be furnished in capacities from 25 to 450 tons per hour.

Recording Instrument

A TEMPERATURE recording instrument with wide application has been developed by Charles Engelhardt, Inc. Used in connection with electric resistance thermometers, it records low temperatures for such purposes as heating and ventilating, refrigeration, chemical plants, etc. Calibrated for use with thermo-electric pyrometers, it records higher temperatures, such as those used in steel plants, heat-treating operations, glass and ceramic plants, etc. When calibrated as a gas analyzer, it may be used to record CO_2 in power plants, SO_2 in chemical and power plants, etc.



MANY PURPOSE RECORDER

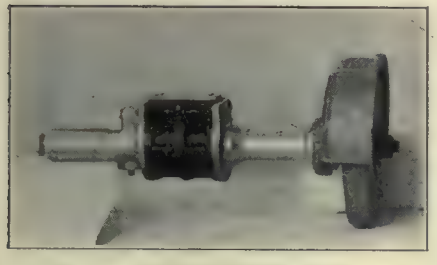
It has been designed for hard service but is accurate in operation. Records consist of dots formed at intervals of 30 or 60 sec. and are caused by the timed operation of a depressor bar on a typewriter ribbon. Power for operation is obtained from an electro magnet which can be furnished to work on standard voltages AC or DC. Recorders can be

furnished to print single records; multiple records up to six all in one color; and multiple records up to six with color distinction between records. Size of device is 16 in. wide, 20 in. high, 10 in. deep. It is equipped with dust-tight cover, containing a large plate glass window.

"Roto" Grinders

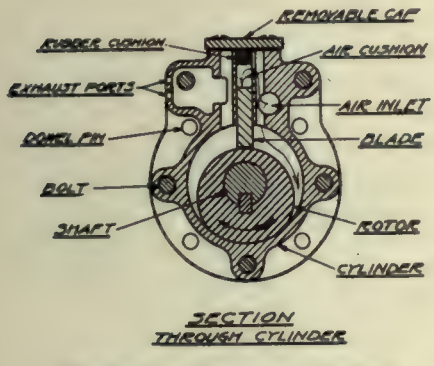
A LINE of portable, pneumatic grinders suitable for general grinding, buffing, polishing, and similar tasks, operated by a rotor on the drive shaft instead of the usual piston has been developed by The Warner and Swasey Company.

By using rotors wear is confined to three moving parts, and it is claimed



GRINDER SHAFT SHOWING ROTORS

that the device will operate many months without attention except occasional oiling. Two rotors are mounted opposite each other on the shaft to provide a steady flow of power with practically no vibration. Air efficiency of

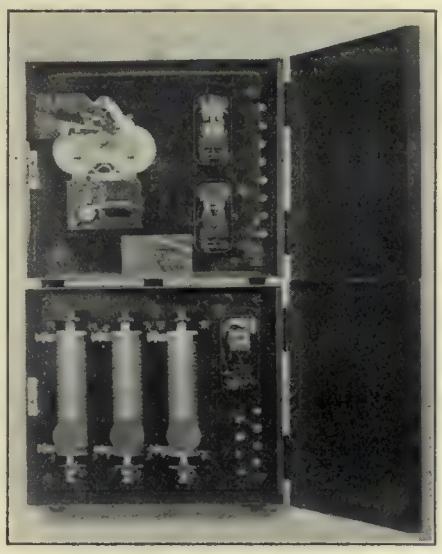


DRAWING OF OPERATING DETAILS

the grinders is said to be high. They operate at pressures from 65 to 90 lb. per sq. in., with an air consumption of 32 to 40 cu. ft. per min.

Power Demand Regulator

SINCE electric current is purchased on the basis of peak loads, it is important to industrial users of electricity that excessive peaks be eliminated. A



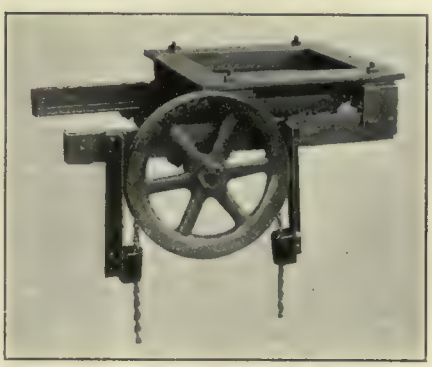
POWER DEMAND REGULATOR

maximum demand regulator, or power governor, developed by Edward T. Moore, is designed to eliminate peak loads, improve load factor, and prevent overloads. It can be used to limit the amount of power taken by any current-consuming device, but is especially adapted for use with large loads, such as are used with electric melting, annealing, and heat-treating furnaces, pulp grinders, etc.

The regulator may be set to limit any load to a predetermined amount and may be used for any length of demand period. Demand can be measured by a graphic curve drawing meter or by an integrated watt-hr. meter. The equipment is mounted in two steel cabinets 14 in. by 11 in. by 4 in., is easy to install, requires little attention, and is reliable in operation.

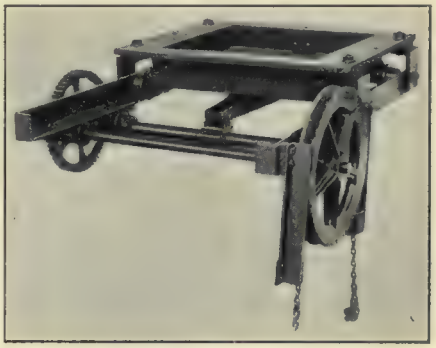
Flat Ash Gate

A STURDY gate designed for use in ash pits, coal bunkers, storage tanks, and similar places where gates must stand abusive treatment, has been developed by Conveyors Corporation of



FLAT ASH GATE

America. The gate frame and body proper are made of large proportioned grey iron castings, accurately machined. Rollers on which the gate operates are machined castings and, with the shaft bearings, are equipped with self-lubricating bronze bushings. Operation is obtained by a rack on the bottom of the gate, which meshes with a pinion keyed to a shaft having a 19¼ in. rag wheel fastened to its end. The wheel is operated by a chain which opens or closes the gate from any distance up to 22 ft. from the gate. None of the moving parts come in contact with the ashes.



ASH GATE SHOWING OPERATING DETAILS

Ten sizes are available, ranging from 18 by 18 in. up to 24 by 30 in. Power-operated gates can be furnished, and any gate can be furnished for firebrick lining.

Combustion Chamber Cover and Soot Blower

A DEVICE to overcome the structural weakness of the usual combustion chamber arch in the setting of a horizontal return tubular boiler, to prevent loss of heat units, to reduce maintenance costs, to prevent the entrance of moisture to injure refractory surfaces, and to facilitate boiler repairs, is being marketed by Quinn and Company, and is called the Quinn Combustion Chamber Cover.

It consists of a rectangular steel casing containing longitudinal steel I-beams which support a heavy refractory wall or lining. Each cover is built according to individual requirements and is shipped as a unit ready to install. In placing it in position, the side and rear walls of the boiler setting are used as a support, insuring a rigid back arch construction. The unit construction eliminates separation of sections and subsequent heat losses and repair bills and the steel casing around the cover protects the refractory lining from moisture. When extensive boiler repairs

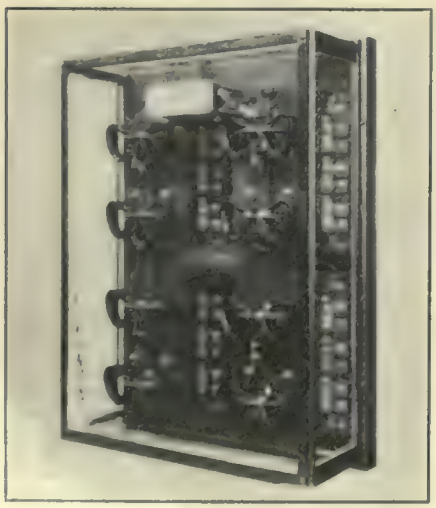
become necessary, the unit cover can be removed readily.

Designed for installation with the combustion chamber cover, the Quinn Soot Blower provides a means by which boiler tubes may be cleaned, quickly and easily, of the accumulation of soot, dust, and fine ash always deposited during boiler operation. This device consists of a frame supporting the vertical travel of a steam manifold. Connected to the manifold are as many blower nozzles as there are vertical rows of tubes. The nozzles pass down through sealed openings in the cover and their position is controlled by a windlass which may be located at any convenient place in the boiler-room.

In operation the manifold is lowered until tips of the blowers are opposite the first row of tubes, steam is turned on, and all tubes in the row are blown at a single operation. The manifold is lowered and succeeding rows are cleaned. Because it works from the rear of the boiler, the draft aids instead of hinders the cleaning operation and dust from it is not carried into the combustion chamber to be redeposited in the tubes. When cleaning is completed, the blowers can be raised out of range of combustion gases and heat. Any size boiler can be cleaned in less than two minutes' time.

New Meters

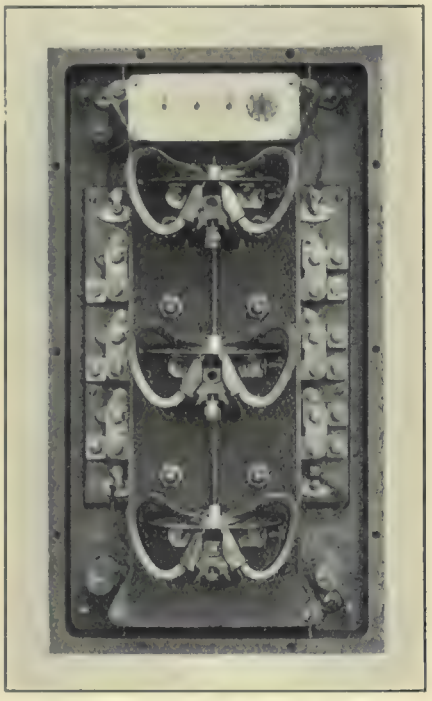
THREE new-type electrical instruments have been developed by the General Electric Company. A totalizing watt-hour meter is designed to meet special problems, such as the determination of combined maximum demand of completely separated electrical circuits. It will totalize four separate polyphase circuits and can be used on either 3-wire, 3-phase, or 4-wire, 3-phase systems.



POLYPHASE WATT-HOUR METER

A 3-element, 4-wire, 3-phase watt-hour meter was developed to provide a device that is not dependent upon a balanced condition of voltage for correct registration.

A new line of switchboard instruments, including alternating and direct



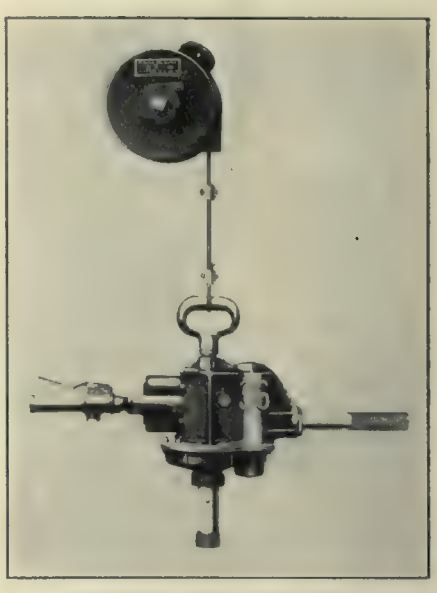
KILOVOLT AMPERE HOUR METER

current ammeters and voltmeters, single and polyphase wattmeters, power factor and frequency meters, and synchronism indicators has been developed. It embodies a 7½ in. diam. dial with a long and open scale.

Balancer for Portable Tools

FOR suspending, balancing, or lifting pneumatic or electric portable tools of all sorts, thus relieving their operators of the effort required to hold them, the Pedwyn Balancer is being distributed by Chicago Pneumatic Tool Company. In contrast with the counterweight method sometimes used for balancing tools, this new balancer requires no guards, is easier to install, may be readily changed from one location to another, and may be suspended from an overhead track or trolley.

Two sizes are available. One has a capacity from 10 to 50 lb., the other



PORTABLE TOOL BALANCER

from 50 to 100 lb. Both sizes are adjustable for any intermediate load within the range of their capacities.

Draft and Damper Regulators

THE Model A Damper Regulator being manufactured by Defender Automatic Regulator Company is designed to control the steam pressure of a battery of boilers by controlling the draft and the speed of the stoker engine, thus obtaining more economical production of steam. It consists of a weighted lever that is operated by varying steam pressure through a diaphragm, a pilot valve and operating cylinder, and an adjustable compensator. The compensator is adjustable so that dampers can be operated on any variation of steam pressure from 1 to 10 lb.

The pilot valve can be operated by hand so that dampers can be operated at times when it is necessary to shut off steam to make repairs, etc.

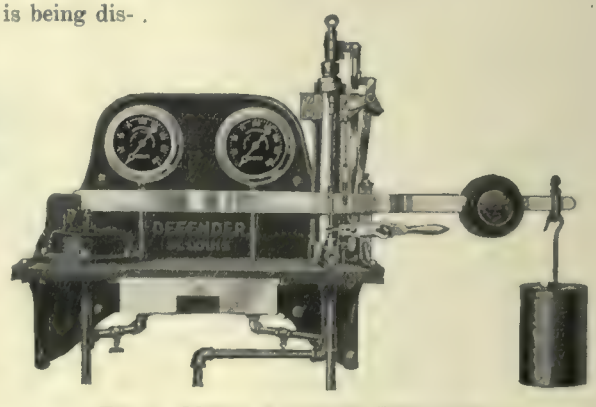


FIG. 1 MODEL A DAMPER REGULATOR

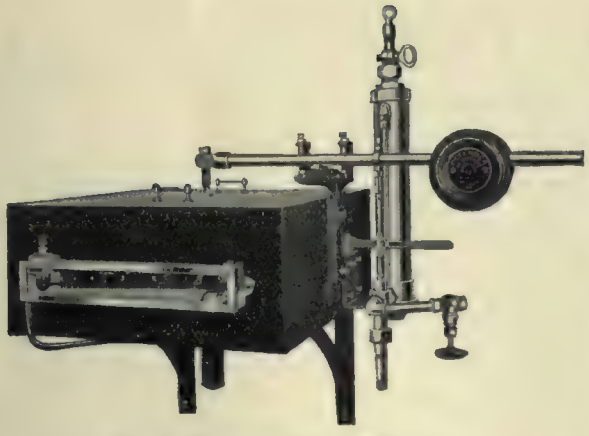


FIG. 2 FURNACE DRAFT REGULATOR

The Defender Automatic Furnace Draft Regulator is a device designed for use in connection with the damper regulator previously described. It is adapted to the control of draft over the fire, of forced draft, stoker-fired boilers or for controlling the air and fuel supply on boilers burning pulverized fuel. It operates by regulating the speed of the forced draft fan in installations where each stoker is furnished with a fan, or, where one fan supplies draft for several furnaces, by regulating damper between fan and stoker.

New Hoist Starter

A REVERSING starter designed for monorail hoist service or other installations where economy of space is essential has been developed by General Electric Company. The starter is very small and compact and is enclosed in a metal case for wall mounting. It may be used with either alternating or direct current. A push button station is provided for operating its four single-pole, mechanically interlocked contactors, which are so arranged that the motor will run only so long as the push button remains depressed.

The starter is suitable for motors up to 5 hp. on voltages from 115 to 550. It has knockouts for ¾ in. conduit. The cover may be locked shut, if desired. Overall dimensions are: width 14 in., height 9 in., depth 6 in.

HOIST STARTER

Instalment Bookkeeping Machine

A NEW bookkeeping machine has been developed by Burroughs Adding Machine Company to aid in overcoming the accounting problems met in handling time payments. It is claimed that this machine greatly speeds up instalment accounting and furnishes neater and more legible records. An individual ledger sheet containing all necessary data on his account is made for each customer.

The left section of platen (see illustration) is for a journal or cash received record which provides a running record and is kept in the machine. The other section is for the customers' ledger records.

Postings on the ledger are automatically printed on the journal also. Dates and ciphers are printed automatically. Tabulation is automatic and new account balances are printed by depressing a "total" key. Payments are distributed into "year of sale" columns on the cash record to facilitate income tax computation. Various automatic mechanical safeguards are provided to prevent errors in posting and at the end of a run of posting the operator can obtain printed evidence of the accuracy of her work.

INSTALMENT BOOKKEEPING MACHINE

Sizing Scale

A DIRECT reading instrument, by means of which the weight for any quantity of material or the quantity required for any weight can be obtained from a small sample, is being manufactured by the Amthor Testing Instrument Company. It is suitable for such materials as paper, rope, felt, wire, rubber, foil, small machine parts, tags, labels, etc.

SIZING SCALE

The scale can be calibrated so that it can read weight for a given quantity, or quantity for a given weight. For example: weight per ream of paper; weight per 108 sq. ft. of felt; weight per 1000 ft. of rope, twine, and wire; net weight per 1000 bolts, nuts, or other finished machine parts; number of sq. in. per lb. of foil; number of ft. per lb. of rope or twine, can all be obtained merely by placing a sample in the scoop. Weights are given directly in grains or grams.

Capacity of the instrument is from 25 grains to 25 lb. It is simple in construction, is sensitive, and contains no springs or links, but operates on the gravity principle, the indicator working on a special spindle.

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 100 magazines; it also includes the publications of some 50 book publishers and professional societies as far as these are of managerial interest to industrial executives. The decimal number at the right of each item is the index number and indicates the place the article or book will take when filed in accordance therewith in the classified subject scheme. If articles are grouped according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. Photostat copies of any magazine article indexed will be supplied by The Ronald Press Company within a year following the date of publication at a price of 25 cents the page. When ordering photostats please identify the article by quoting from the index: (1) Title of article; (2) Index number; (3) Name, date, and page number of periodical in which the item appears. A remittance of 25 cents a page should accompany the order. The books and pamphlets indexed can be procured from The Ronald Press Company or from their respective publishers.

Industrial Buildings and Plant Maintenance

Buildings and Equipment

Air Conditioning for the Manufacture and Storage of Candy. 658.25
Eilert Nesdahl. *Candy Factory*, March 1925, pp. 27-28. Based on the experience of Brandle and Smith Company.

An Analysis of Building Prospects for 1925. 658.2
Buildings, February 1925, pp. 393-398. Illus. All types of construction show promise of equaling or bettering 1924. Factors influencing 1925 building.

Building Construction Under Winter Conditions. 693.5
C. D. Harrington. *The Engineering Journal*, February 1925, pp. 76-77. With special reference to excavating, preparation of foundations, and concrete and masonry work.

Cleaner Water for Factory Uses. 658.238
Factory, February 1925, pp. 284, 285. Applications of traveling and stationary screens to remove refuse and salvage material in a factory water supply.

Costs in 44 Employees' Lunchrooms. 658.2:658.383
Russell J. Waldo. MANAGEMENT AND ADMINISTRATION, April 1925, pp. 337-342. Illus. A survey covering 44 manufacturing plants in eastern and central states, showing types of buildings in use for cafeterias, typical layouts, floor space allotted, cost of equipment and operation, and increases in production coming about.

Developments in Mill Lighting. 658.242
Roy A. Palmer. *Textile World*, February 7, 1925, pp. 411, 413. Size and location of lighting units, methods of wiring.

Effect of Power Production Costs on Colliery Valuations. 658.2
Iron and Coal Trades Review, January 16, 1925, p. 100. Good plant layout, and adequate material handling and power equipment increase valuation considerably.

Fireproofing of Structural Steel. 658.2
A. W. Sinnamon. *The Iron Age*, March 5, 1925, pp. 694-696. Illus. Suggested construction details for obtaining maximum fire resistance in steel construction.

Heating Systems for Textile Mills. 658.25:677
Charles L. Hubbard. *Textile World*, March 7, 1925, pp. 87, 91, 97, 99. Illus. Description of various methods, with advantages and disadvantages of each.

Illumination and Industrial Efficiency. 658.24
Sanford DeHart. *Industrial Management*, February 1925, pp. 108-111. Illus. Influence of illumination upon production, health, and number of accidents.

Industrial Ventilation in Theory and Practice. 658.25
Dr. Leonard Greenburg. *National Safety News*, March 1925, pp. 27-29. What proper ventilation is, what it does to productive efficiency, and how it may be attained.

Lighting Facts to Ponder Over. 658.24
C. E. Weitz. *American Machinist*, February 19, 1925, pp. 295-300. Shows loss in industry chargeable to poor illumination. Gives the fundamental principles of good lighting, discusses perception, discrimination, contrast and sustained vision, and shows the use of foot-candle meter.

The Modern Fine-Paper Mill: Design and Equipment. 658.2
H. M. Grasselt. *Engineering-News Record*, February 12, 1925, pp. 274, 275, 276. Deals with factors which concern the location of a fine paper mill, details of building design, plant layout, lighting, ventilation and material-handling equipment.

New Passenger Car Repair Shops and Stores Building for Wabash Railway. 658.2
Railway Review, February 7, 1925, pp. 257-267. General arrangement, details of lighting, heating, ventilation, plan of operation, storeroom, etc. Buildings erected in 131 days after fire had destroyed old structures.

Physical Properties of Structolite. 658.22
Buildings, February 1925, pp. 403-406. Illus. Special gypsum cement, either precast or in monolithic work, gives light, strong, fireproof wall.

Planning and Building a Large Motor Vehicle Plant. 658.2
Edwin M. Chance. *Engineering-News Record*, February 26, 1925, pp. 344-349. Gives the method of approach to technical problems in the layout and construction of a motor truck assembling plant and shows how these particular problems were solved. Drawings and reproduced photographs of the completed plant indicate the results and solutions obtained.

Pouring Concrete in Zero Weather. 693.5
C. N. Shanly. *The Engineering Journal*, February 1925, pp. 78-80. Illus. Details of a construction project carried on under severe winter conditions.

A Shop Lay-Out. 658.2
(A Modern Shop Planned for Building Automatic Printing Presses.) Wm. M. Kelly. *American Machinist*, February 12, 1925, pp. 281-284. Detailed layout of a machine shop for progressive production by the continuous flow method.

Ventilation of Paper Machine Rooms. 658.25
R. Skagerberg. *Paper Trade Journal*, February 5, 1925, pp. 139-144. Illus. Reducing costs by efficient use of air and heat.

Maintenance and Repair

Maintenance: Gearing Up Both Plant and Equipment for Low-Cost Production. 658.581
K. D. Hamilton. *Factory*, February 1925, pp. 256-260. Discusses the application of electrical motors both in group and individual drives, showing numerous applications for low-cost production.

Modern Painting Methods Used in the Everett Shops, Boston. 658.58
Electric Railway Journal, January 31, 1925, pp. 173-178. Illus. Methods of paint preparation, storage, testing, and utilization.

General Management and Policy

Administration and Policy

The Content of Courses in Management—I. 658(07)
Joseph W. Roe and Nathaniel G. Burleigh. *Bulletin of the Taylor Society*, February 1925, pp. 5-14. Comparison of the topics in "Management's Handbook" with the subjects in the courses in Industrial Engineering at New York University and general discussion of the material which should enter management courses.

Deserving a Manufacturing Profit. 658
B. A. Franklin. MANAGEMENT AND ADMINISTRATION, April 1925, pp. 329-332. Industry is a service and the manufacturer who makes a profit must deserve it by the service that his unit renders.

Fighting Unfair Competition. 381
F. A. Fall. *Credit Monthly*, March 1925, pp. 22, 44. Free industry lines up against prison labor.

The Function of Directing. 658
J. F. Marsden. *Cassier's Industrial Management*, February 1925, pp. 160-161. Coordination and control are the vital elements in the task before an industrial administrator.

The Future of Industry. 658
J. A. Russell. *Michigan Manufacturer and Financial Record*, February 21, 1925, pp. 7-8. Industrial expansion and plant location factors, with special reference to the Detroit district.

How Taylor Introduced the Scientific Method Into Management of the Shop—II. 658
Charles De Freminville. *Bulletin of the Taylor Society*, February 1925, pp. 30-40. Discusses the way in which scientific management or the Taylor system has been introduced into French industry. Contrasts are drawn between American and French methods and practices.

Industrial Standardization. 658.516
Engineer, January 30, 1925, p. 129. Abstract of address by C. le Maistre, secretary British Engineering Standards Association, before Czecho-Slovakian Engineering Standards Committee.

The Practical Interpretation of Index Numbers. 311
E. C. Snow. *International Labour Review*, February 1925, pp. 180-199. Suggests that present price indexes be replaced by separate indexes of prosperity for all important industries, the latter to be then combined into a general index of industrial prosperity.

Production Costs and Material Prices in Engineering. 338.5:620.1
H. Quigley. *World Power*, February 1925, pp. 66-71. Illus. International prices, comparisons, tendencies, and production costs in iron, steel and copper industries, principally for products entering into electrical and machinery manufacture.

Scientific Management Made Clear—II. 658
Irving Fisher. *Bulletin of the Taylor Society*, February 1925, pp. 41-61. An extended review of Copley's life of Taylor.

Standardization and Simplified Practice in the Textile Industry. 658.516
A. E. Foote. *Textile World*, February 7, 1925, pp. 176-178. Survey of progress made.

Standardization of Tool Steel. 658.516
(Zur Normung der Schneidstähle.) K. Brandl. *Werksstattstechnik*, February 1, 1925, pp. 103-4. Illus. Discussion of proposed provisions and designations.

Then There's the Case for Management. 658
Richard F. Grant. *The Nation's Business*, March 1925, pp. 42, 44, 46. The position and responsibilities of management in our present business system.

What Is a Standard? What Is Standardization? 658.516
(Was ist eine Norm? Was ist Normung?) Dr. Porstmann. *Werkstattstechnik*, January 15, 1925, pp. 69-72. A standard is defined as a similar solution of a repetitive task, and standardization as the foundation principle of each organization.

Economics

The Business Cycle. 338.97
Luther D. Burlingame. *American Machinist*, March 5, 1925, pp. 371, 372. Examples of a business cycle chart published in 1897 and the same chart brought up to date. Sharpe's "trade circle" developed by Lucian Sharpe of the Brown and Sharpe Manufacturing Company more than 20 years ago is also shown.

Economies of Business Cycles. 338.97
A. B. Adams. McGraw Hill Book Company, New York. 268 pp. $2.50. A discussion of business cycles with the object of analyzing causes and effects of cycle forces. The author does not believe that cycles are inevitable nor that each business cycle is generated by the preceding one and, in turn, generates a succeeding one. In his analysis of causes he has tried to show the fallacy of the rather general belief that cyclical fluctuations are initiated by forces which "move within a charmed circle." He believes that cyclical changes are caused by specific forces which can be controlled and makes definite suggestions for controlling them.

German Finance and Industry. 332
Elmer E. Staub. MANAGEMENT AND ADMINISTRATION, April 1925, pp. 321-324. Present conditions that should be understood by American manufacturers.

Industrial Opportunities in California. 658.21
F. L. S. Harman. *Central Manufacturing District Magazine*, February 1925, pp. 34-38. Transportation, raw material resources, labor supply, market, banking facilities, etc.

John A. Brashear. The Autobiography of a Man Who Loved the Stars. 92
Edited by W. Lucian Scaife. Houghton Mifflin Company, New York. 262 pp. $4. Famed for his scientific achievements which placed him in the foremost rank of makers of astronomical lenses and precision instruments, his overflowing love for mankind made even a stronger bid for the distinctions which were thrust upon him. Known as "Uncle John" by thousands, he was the true friend and wise counselor of newsboys and bank presidents, of millionaires and paupers. The story of his rise from obscurity to the exalted position he occupied at his death, told in a way that is constantly belittling his own importance, is intensely interesting and should be read by everyone who believes that, in this materialistic age, high ideals and consecration of a life to love, work, and service are futile.

The Pay-Roll Dollar in Industry. 331
S. F. Fannon. *Modern Mining*, January 1925, pp. 5-8. Illus. Vital importance of the human element as compared with the apparent importance of plant equipment.

Management

Cost of Fatigue in Steel Plants. 658.544
Haynes Porter. *The Blast Furnace and Steel Plant*, February 1925, pp. 73-75. Ideas and suggestions applicable to other industries.

The Destructive Element in Reorganization. 658.56
W. V. Hiscox. *Engineering Production*, February 1925, pp. 43-44. How one concern pruned a cumbersome system so that it accomplished its purpose of controlling production efficiently and cheaply.

Diversificd Activities Are Essential to Success in Commercial Machine Shop Work. 658
H. B. and O. C. Sabin. *Iron Trade Review*, March 5, 1925, pp. 621-624. Illus. By taking on the manufacture of various new products, a shop has been able to weather the post-war slump profitably.

Economies of Manufacturing in Dye Plants. 658.5
(Betriebswirtschaft in Färbereien.) H. Thiesenhusen. *Zeitschrift des Vereines Deutscher Ingenieure*, January 31, 1925, pp. 124-126. Discusses the factors of operation and equipment.

Follow-Up System of Purchases. 658.7
W. J. Hiscox. *Machinery*, March 1925, pp. 536-538. Illus. Description of system and its operation.

Foundry Work and the Draughtsman. 658.56
A. Sutcliffe. *Foundry Trade Journal*, January 22, 1925, pp. 75-77. Illus. Points out the need of co-operation between drawing-room, pattern shop, and foundry.

How to Cut Costs. 658.5
Lemuel Johnson. *Paper*, February 5, 1925, pp. 661-662. Applied to paper industry.

How to Cut the Factory Printing Bill. 651.5
Albert J. Jacquot, Jr. *Factory*, February 1925, pp. 269-271. Methods adopted by the General Electric Company to control the cost and quantity of accounting forms and other printing.

I Find Out How to Cut Expense. 658
T. L. Hoffman. *System*, March 1925, pp. 297-302, 342, 344, 346-9. Illus. Methods used to cut production, selling and office expenses in the Kansas Flour Mills Company.

Instruments and Gauges. 621
H. A. Randall. *Engineering Production*, February 1925, pp. 45-52. Illus. Description, application, and operation of large number of precision measuring instruments.

Office Management. 658.16
William Henry Leffingwell. A. W. Shaw Co., Chicago. 850 pp. $5. A very complete manual on the principle and practice of scientific management applied to offices. The book is divided into four main parts. Part 1 treats with the theory and principles underlying office management, emphasizing the necessity for standardized practice. Part 2, an analysis of the problem of office management, outlines methods for determining what the problem is and how to seek its solution. Part 3 discusses standardization of the plant or physical conditions, standardization of equipment and materials, standardization of methods, and standardization of personnel. Part 4 gives methods of control for assuring adequate performance. Information contained is practical, based on successful experience, and should prove valuable to all industrial executives who, as part of their duties, manage the activities of an office force.

The Possibilities of Preferred Numbers in Civil Engineering. 658.516
S. Wilmot. *Buildings*, February 1925, pp. 407-411. Reinforcing and structural steel, sieves, cement bags, concrete mixers, etc., are adapted to grading by sizes for convenience and economy.

Quick Turnover Brings Problems. 658
E. J. Kulas. *Michigan Manufacturer and Financial Record*, February 28, 1925, pp. 5, 25. Highly organized plants are required, built for large, flexible production, and manned, financed, equipped and managed to keep abreast of industry.

Reducing Idle Machine Time. 658.5
E. F. Ross. *Iron Trade Review*, March 5, 1925, pp. 631, 672. Explains the service which machine tool builders offer users by supplying repair parts quickly, and the difficulty of doing so for old equipment.

Specifications for Office Supplies. 658.7
Robert Sherran. MANAGEMENT AND ADMINISTRATION, April 1925, pp. 333-336. Specific information for the buyer of office supplies concerning uses, advantages and disadvantages of supply items with table of labor costs.

Steel and Light Alloys as Engineering Materials. 620.1
L. Aitchison. *Iron and Coal Trades Review*, January 30, 1925, pp. 174-5. Comparisons of various materials and their properties and suitability for use.

Using Simplification to Increase Our Sales. 658.516
Julius Kahn. *System*, February 1925, pp. 151-156, 220-222, 224. Illus. Advantages of simplification and standardization shown by experience of Truscon Steel Company.

What the Lack of Standardization of Track Bolts Costs. 658.516
A. L. Greene. *Railway Engineering and Maintenance*, February 1925, pp. 44-47. Illus. Absence of standards and making of exacting specifications increases cost to consumer.

Power Generation and Transmission

Fuel

Burning of Wood Refuse. 658.261
R. L. Beers. *Paper Trade Journal*, February 5, 1925, pp. 157-159, 161, 165, 167. Illus. Equipment and operating methods suitable for obtaining heat units from waste wood.

The Combustion of Pulverized, Liquid, and Gaseous Fuels. 621.18
J. B. C. Kershaw. *World Power*, February 1925, pp. 78-85. Illus. Descriptions, capacities and power requirements of various types of pulverizers, and economies of the three different kinds of fuels under combustion.

Development of Pulverized Coal as a Boiler Fuel. 621.18
H. W. Brooks. *Combustion*, March 1925, pp. 186-190. Illus. Historical discussion of progress in use of pulverized coal.

Oil Facts for the Coal Men. 621.18
C. W. Edwards. *Black Diamond*, February 14, 1925, pp. 180-181; also February 21, 1925, pp. 210-211. Oil production and distribution. History and facts point to steadily rising prices and diminishing supplies.

Powdered Coal in a Malleable Casting Plant. 621.18
F. L. Wolf and Wm. Romanoff. *Foundry Trade Journal*, January 22, 1925, pp. 78-9. Experiences of the Ohio Brass Company favor its use in manufacturing and in steam generation.

Powdered Coal, the Modern Industrial Fuel. 621.18
Roderick D. Donaldson. *Paper Trade Journal*, February 5, 1925, pp. 105-107. Lower fuel costs, smaller labor pay-rolls, decreased maintenance charges made possible by use of powdered coal.

Power Equipment

Air Coolers for Turbo-Generators. 621.5
Engineering Progress, January 1925, pp. 11-13. Applications, requirements, and operation of air filters and coolers.

Automatic Feed Water Regulation. 621.18
Walter Smith. *Mechanical World*, February 6, 1925, pp. 88-89. Advantages and types of equipment used.

Fuel Oil Heaters—Their Care and Operation. 621.18
Allen F. Brewer. *Combustion*, March 1925, pp. 200-204. Illus.

Steam Prime Movers for the Paper Mill. 621.18
R. W. Leeper. *Paper Trade Journal*, February 5, 1925, pp. 146-149. Analysis of various types of equipment suitable for plants requiring steam for process work.

Superheat and Superheater. 621.18
J. R. Hannan. *Mechanical World*, February 13, 1925, pp. 102-104. Illus. Economies possible by use of superheated steam, methods and cost of obtaining it, and brief descriptions of equipment needed.

Waste-Heat Boilers. 621.18
J. N. Williams. *The Gas World*, February 21, 1925, pp. 140-141. Possibilities for economy in steam generation in utilizing heat in waste gases.

What Should a Good Fan Engine Regulator Do? 621.6
H. H. Shugart. *Steam Power*, February 1925, pp. 5, 10.

The Why of Boiler Plant Instruments. 621.18
R. E. Cramer. *Combustion*, March 1925, pp. 193-195. Practical, non-technical analysis of applications and advantages.

Power Plant Operation

Can We Standardize Power Plant Lubrication?—II. 621.89
Allen F. Brewer. *Industrial Management*, February 1925, pp. 70-75. Illus. Application and action of oil in various types of prime movers.

Combustion Control. 658.26
T. A. Peebles. *Mechanical Engineering*, March 1925, pp. 193-196. Presents the advantages of combustion control and deals with control of steam pressure, air pressure, feed water, superheat, tube replacements and clinker formation.

How We Reduced Our Power Costs. 658.26
Industrial Management, February 1925, pp. 112-115. Five examples of savings brought about by improved methods and new equipment.

The Importance of Boiler Plant Records. 658.26
G. M. Gibson. *Industrial Management*, February 1925, pp. 86-88.

The Improvement of Power Factor. 658.26
M. Walker. *World Power*, February 1925, pp. 86-90. Illus. Analysis of equipment which requires a lagging current. (To be followed by an article on corrective measures.)

New Methods Cut Power Plant Costs. 658.26
C. E. Killinger. MANAGEMENT AND AD-

MINISTRATION, April 1925, pp. 325-328. Illus. Study of steam generation and utilization, and coal handling, with purchase of some new equipment, enables the Willys-Morrow plant to save $66,000 per year.

The Physical Side of Concentration in Boilers. 621.18
R. W. Andrews. *Steam Power*, February 1925, pp. 7, 12, 14. Physical results of passage of insoluble material through steam lines with some suggested remedies.

Power as a By-Product of Process Steam. 621.18
W. G. Diman. *Power*, February 24, 1925, pp. 286-287. Description of power plant equipment used by Amoskeag Manufacturing Company to provide power and process steam for a woolen department. The combination yields high efficiency.

Power Factor Correction. 658.26
L. W. W. Morrow. *Journal of the American Institute of Electrical Engineers*, February 1925, pp. 150-156. Means and economies of corrections from the public utility and customer standpoints.

Secures Uniformity in Ladle Iron. 621.18
H. R. Simonds. *Iron Trade Review*, March 5, 1925, pp. 628-630. Illus. Pulverized coal system applied to waste heat boiler and reverberatory-type melting furnaces gives operating advantages.

Standardization of Textile Mill Lubrication. 621.89
Allen F. Brewer. *Textile World*, March 7, 1925, pp. 79, 81, 83. Illus. Advantages of reclamation of lubricants, what oil purification consists of, how it is effected, and a description of purifying system.

Steam—Economy of Generation and Utilization. 621.18
C. A. Schlegel. *Gas Age-Record*, February 28, 1925, pp. 293-295, 301. Charts. Practical discussion of fundamentals necessary for steam economy and their application to boiler operation.

Power Transmission

Flexible Couplings. 621.82
Charles H. Clark. *Machinery*, March 1925, pp. 509-517. Illus. Commercial types, their characteristics and general applications.

Gearing Up Equipment for Low-Cost Production. 658.58
K. D. Hamilton. *Canadian Machinery*, March 5, 1925, pp. 30-31, 35, 36. Illus. Proper maintenance of pulleys, chains, gears, and clutches an essential factor in the efficient transmission of power.

Tests of Belting. 621.85
R. F. Jones. *Paper*, February 12, 1925, pp. 149-153. Non-technical summary of research on applications of leather belting made by Leather Belting Exchange Foundation.

Marketing and Distribution

Advertising

Advertising That Pays. 659.1
F. R. Plumb. *System*, March 1925, pp. 311-315, 352-3. Illus. Market analysis and advertising methods of the Fayette R. Plumb Company, makers of hammers, axes, etc.

Brightening Copy with Simile and Exaggeration. 659.1
Henry Eckhardt. *Advertising and Selling Fortnightly*, February 11, 1925, pp. 25, 44, 45.

Don't Make a Beast of Burden of the Advertising Appropriation. 659.1
A. H. Deute. *Printers' Ink*, February 19, 1925, pp. 17-20. Use advertising appropriations for advertising only, not as a catch-all for miscellaneous selling expenses.

Do You Make Booklets on a Footage Basis? 659.13
C. B. Larrabee. *Printers' Ink Monthly*, March 1925, pp. 21-23. Illus. Suggestions for relieving monotony in advertising booklets.

The Look-Down Vista Shows Your Product in a New Light. 659.13
W. Livingston Larned. *Printers' Ink*, February 26, 1925, pp. 25, 26, 28. Value of "bird's-eye views" for illustrating advertising displays.

Making the Small Appropriation Do a 100 Per Cent Job. 659.1
Leslie H. Allen. *Printers' Ink Monthly*, March 1925, pp. 41-42. Suggestions for most efficient use of small advertising appropriations.

A Scientist Looks at Advertising. 659.1
F. C. Brown. *The Nation's Business*, March 1925, pp. 32-34. Illus. Some ideas for advertising practices taken from the experiences of the Bureau of Standards.

Waste in Advertising. 659.1
Harry Tipper. *Automotive Industries*, February 19, 1925, pp. 293-295. Suggestions for locating waste and methods of preventing it.

What the Advertiser Wants to Know About Advertising. 659.1
G. Lynn Sumner. *Advertising and Selling Fortnightly*, February 11, 1925, pp. 19-20, 58, 59. Illus. What information is necessary to assure effective and profitable results from an advertising campaign.

Selling

American Guarantees Abroad. 382
James True. *Printers' Ink*, February 19, 1925, pp. 25, 26, 28, 33, 34. Principles and practices for use of product guarantees in foreign markets.

Cancellation Evil Exacts Heavy Toll From the Industry. 658.88
E. L. Shaner. *Iron Trade Review*, February 26, 1925, pp. 559-561. Illus. Losses sustained by cancelling orders when material is in process or completed total large sums.

Corsairs of Credit. 658.882
F. S. Tisdale. *The Nation's Business*, March 1925, pp. 52, 54, 56. Illus. Schemes used by unscrupulous persons to defraud creditors and what National Association of Credit Men is doing in opposition.

Departmental Teamwork Is Key to Improved Distribution. 658.8
E. L. Shaner. *Iron Trade Review*, February 19, 1925, pp. 499-501, 542. Illus. Sales favorable from one standpoint may be detrimental from another. This points to the necessity of a co-ordinated analysis of selling to show its effects on all departments.

Enlightening Consumer Is Foundryman's Task. 658.8
W. J. Corbett. *The Foundry*, March 1, 1925, pp. 181-185. Illus. Co-operation between purchaser and foundry results in better products at less cost. Suggestions for its attainment with emphasis on foundrymen's needs.

Financing Automobile Sales Abroad. 382
George F. Bauer. MANAGEMENT AND ADMINISTRATION, April 1925, pp. 365-368. Illus. Methods used to protect the manufacturer against loss, and need for making present domestic system international.

The High Cost of Salesmen Who Don't Sell. 658.8
A. H. Deute. *Printers' Ink*, February 26, 1925, pp. 69, 70, 72. Consumer-demand aroused by advertising must be crystallized into positive action by selling a belief in its presence to the dealer.

How Far Can a Manufacturer Push the Trial Offer? 658.855
Robert K. Malcolm. *Advertising and Selling Fortnightly*, February 11, 1925, pp. 21, 70, 72. Relative to the tests to which the product may be subjected by the prospective buyers.

How Many People Will Buy What You Have to Sell? 658.8
Roland G. E. Ullman. MANAGEMENT AND ADMINISTRATION, April 1925, pp. 361-362. Possibility of making almost exact determinations of sales possibilities from market analyses and close study of available business and industrial statistics.

How One Firm Made a Successful Bid for Trade. 658.5
W. S. Hiscox. *Business Organization and Management*, February 1925, pp. 325-329. Outline of methods used to increase output from 25 to 200 units per week, reduce selling price 30 per cent, with little increase in pay-roll and less than $1000 spent for new equipment.

Improved Distribution Pays Big Dividends to Industry. 381
E. L. Shaner. *Iron Trade Review*, February 12, 1925, pp. 443-445, 454-455. Illus.

Contrasts present-day simplification of products, transportation facilities, and coal situation with the chaos of 10 years ago.

Making a Graphic Analysis of the Monthly Sales Statement. 658.817
R. von Huhn. *Printers' Ink Monthly*, March 1925, pp. 55-56, 58, 63. Charts.

Methods of Compensating Salesmen. 658.32:658.8
Metropolitan Life Insurance Company. 16 pp. Leaflet. Discussion of various methods with advantages and possible disadvantages of each.

Planning Salesmen's Territories. 658.85
G. E. Bettner. United States Chamber of Commerce, Washington. Pamphlet. 12 pp. An analysis of methods used by various selling organizations with definite suggestions for making better use of salesmen's time.

Selling Castings—VII. 658.85
Foundry Trade Journal, January 22, 1925, p. 73. A few answers to overcome sales resistance.

Selling New Types of Machine Tools. 658.8
G. M. Meyncke. *Machinery*, March 1925, pp. 527-529. Illus. Best ways of presenting facts and avoiding erroneous impressions.

The Setting of Credit Limits. 658.882
C. L. Jamison. *Credit Monthly*, March 1925, pp. 36, 38-9. Net current assets an important basis.

The Technique of Market Analysis—I. 658 8
Arthur Livingston. *Bulletin of the Taylor Society*, February 1925, pp. 18-24. Examples of market analysis methods by questionnaires, investigations, sales statistics and through salesmen and prospects.

Yes, We Can Cut Marketing Costs. 381
Herbert Hoover. *The Nation's Business*, March 1925, pp. 48, 50, 74, 76, 77. Enumerates sources of waste in distribution, outlines what the government is doing to eliminate them, and tells how industry can help itself.

The Traveling Sales Manager Comes to Bat. 658.81
Donald Argyle. *Printers' Ink*, February 19, 1925, pp. 57-58, 60, 64. Advantages of having sales manager travel over his territory instead of becoming a desk man.

What Are Your Salesmen Saying? 658.85
Harry T. Bussman. *Printers' Ink Monthly*, March 1925, pp. 27-28, 102. Some of the mechanics of leading the customer to the buying point.

Who Sells to the Argentines? 382
E. R. Murphey. *System*, March 1925, pp. 325-9, 412. Illus. Method used by North American firms engaged in exporting to Argentina and Uruguay.

Shipping

Container Specifications. 658.78844
Floyd T. Smith. MANAGEMENT AND ADMINISTRATION, April 1925, pp. 349-352. Illus. Uses, requirements, and designing methods for containers.

Five Rules We Have Used to Lower Truck Costs. 658.281
W. L. Conner. *System*, March 1925, pp. 318-19, 404-5. Illus. Study of delivery costs on gasoline and electric trucks at the Freihofer Baking Co., and methods used to reduce costs.

Material Handling and Production Control

Material Control

How to Maintain Proper Inventory Control. 658.787
H. S. Owen. *Industrial Management*, February 1925, pp. 83-85. Illus. Method of determining by means of a chart the proper amount of inventory to carry for economical operation.

Modern Stores Control. 658.78
J. L. Denneen and Karl F. Brown. *Commerce Journal*, February 1925, pp. 5-7, 29-30. Methods used in district stores of Southern Pacific Company at Los Angeles.

A Works Ordering and Shop Requisitioning System. 658.7
W. S. Findlay. *Cassier's Industrial Management*, February 1925, pp. 155-157. Forms. A generally applicable method for systematizing purchasing operations.

Mechanical Handling

Haulage—XII: Aerial Tramways. 621.85
Adam Crawford. *Coal Mine Management*, February 1925, pp. 52-6, 58, 60, 62, 64, 66. Illus. Description of various systems and their operation.

My Problem of Moving Delicate Parts. 658.78
A. B. Schupp. *Factory*, February 1925, pp. 265-268. Practice of the Moto-Meter Company, in handling 330,000 small parts daily.

Standardization as Applied to Bucket Elevators. 658.516
Matthew W. Potts. *Industrial Management*, February 1925, pp. 116-121. Illus. Suggestions for standardizing the materials and design of the casing, and advantages which will result to manufacturers and users.

21 Material Handling Installations Which Have Saved Money. 658.281
G. E. Hagemann. MANAGEMENT AND ADMINISTRATION, April 1925, pp. 357-359. Use of trucks, tractors, truclifts and cupola charging machines in 21 different plants, giving data and tables of costs and savings.

Production Methods and Control

Abrasive Wheels and Some of Their Uses in Production Grinding. 621.92
H. A. Charles. *Western Machinery World*, February 1925, pp. 53-55, 75. Illus.

Cleaning Blast-Furnace Gas. 658.5
A. E. Rowe. *Iron and Coal Trades Review*, January 23, 1925, pp. 125-129. Illus. Points out wastes incident to the loss of 60 per cent of coke in the form of gas, and gives preventive methods and possible savings.

Controlled Production of Knit Goods. 658.5
Herbert C. Gates. MANAGEMENT AND ADMINISTRATION, April 1925, pp. 343-346. Illus. Detailed description of methods used by The William Carter Company.

Difficulties Overcome in Airplane Manufacture. 658.5
C. Roy Keys. MANAGEMENT AND ADMINISTRATION, April 1925, pp. 373-374. Illus. Some of the manufacturing problems met and overcome by Curtiss Aeroplane and Motor Company, solutions of which contain valuable suggestions to other manufacturers.

Dispelling Drudgery in the Hot Mill. 658 5
J. D. Knox. *Iron Trade Review*, February 19, 1925, pp. 503-506, 543. Illus. Description of mechanical doubler and tin pot feeder, with cost comparisons under old and new methods.

Improving Car Department Service—II. 658.5
L. K. Silleox. *Railway Mechanical Engineer*, February 1925, pp. 104-7. Illus. Methods used by the Chicago, Milwaukee & St. Paul R. R. for reporting bad order cars and repairs. Hiring, discipline and advancement of men.

Method of Finding Minimum Cost Quantity in Manufacturing. 658.5
Ralph C. Davis. MANAGEMENT AND ADMINISTRATION, April 1925, pp. 353-356. Development of formulas and construction of charts for determining most economical quantities for lot manufacture.

Methods of Metal Melting. 651.76
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395—412

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Cutting Down the Waste Pile

Costs and Benefits of Industrial Waste Elimination

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WE Americans are now enjoying a higher standard of living—a higher level of comfort—than any other people on earth; but in this land of plenty we hear a rather frequent note of protest about the steadily increasing cost of living. It comes first from one quarter, then from another; from this group, then from that. The question arises: "How long before this protest will become general?" How long before we are confronted with one or the other alternatives usually applied when the problem of "making the income cover the outgo" becomes acute? And then, shall the way out of difficulty be through strikes for more wages, or through "buyers' strikes," resulting in either case, for the time being at least, in the acceptance of a lowered standard of living?

If "in times of peace, it is proper to prepare for war"—then certainly in the midst of prosperity it is proper to prepare against industrial disruption and depression. Wouldn't it be wise to look around, and "choose our exit" now?

Employers generally are in a better position than either their employees or their customers to estimate the rate of approach of growing reactions to rising living costs. They know on the one hand how much pressure for more wages is generating among the factory workers, and on the other, how much opposition to rising prices is being reflected in the day-to-day experiences of the sales force. The employer, therefore, is better able to direct his activities along lines which will maintain the equilibrium of adequate wages, reasonable prices, and volume business. The major question is: What method shall the employer choose in meeting these problems as they arise? Will he resist to the utmost the desire for more wages, or will he increase his advertising, cut prices, and otherwise intensify his sales effort? A third avenue, which offers greater possibilities than either of the others for successful continuation of his business, is the elimination of waste in all phases of his enterprise.

No less an authority than Secretary Hoover made the statement a short time ago that through elimination of waste industry had already made savings to the producer, the distributor, and the consumer, estimated at over $600,000,000 a year. Mr. Hudson cites numerous examples of how this has been done and the tremendous possibilities for future savings. Waste elimination is a demonstrated fact—a vast asset to industry.

The purpose of this and a subsequent article is to discuss the various methods of eliminating waste with the view to stimulating interest in the subject. The writer believes that such discussion will assist in expediting the elimination of waste in industry.

Industrial waste is the loss resulting from our failure to utilize intelligently the potential productive capacity of materials, machinery, and men. It includes not only the unused portion of the material and human resources employed in the production of the necessities and comforts of life, but also that portion of these resources absorbed by the production of superfluous and unnecessary varieties of goods. Obviously the maximum effective utilization of these great resources requires the scientific elimination of present wastes.

Whether or not such utilization is imperative at this time is necessarily a moot point. The writer urges that "waste elimination" is just as much a part of getting out the product as is any other process employed for that purpose. The effort in any business is to produce a specific result in the most economical manner, yet unless constant watch is kept over every

step in the processes, wastes will, and do, creep in. To be constantly watchful of wastes of every sort, to study them continually, and to work persistently to overcome them, is fully as much a responsibility of management as to see that the product is made and delivered according to specification and to schedule.

From the economic standpoint, it is essential that waste elimination be included as a fundamental of managerial practice. So long as we fail to recognize it as such, the question is not "What will we gain from waste elimination" *but* "What will we lose by failing to give it the consideration it deserves?"

Herbert Hoover, as Secretary of Commerce, says:

> We have probably the highest ingenuity and efficiency, in the operation of our industries, of any nation. Yet our industrial machine is far from perfect. The wastes of unemployment during depressions, from speculation and overproduction in booms, from labor turnover; from labor conflicts; from intermittent failure of transportation of supplies of fuel and power, from excessive seasonal operation, from lack of standardization, from losses in our processes and materials—all combine to represent a huge deduction from the goods and services that we might all enjoy, if we could do a better job of it.

The Survey of Waste in Industry, conducted by Mr. Hoover, when president of the American Engineering Council, shows an average of nearly 50 per cent waste in six of our leading industries. Applying this factor of waste to our annual fabricated production (which amounted to more than $60,000,000,000 in 1919) we have an annual waste bill of $30,000,000,000. Since this bill is now paid for in the prices charged the ultimate consumer, any appreciable reduction of this huge loss *should* result in lower prices to him. The margin thus afforded him between income and expenses would maintain his purchasing power, and would act as a factor of safety against unemployment.

Waste elimination is of primary importance in keeping the wheels turning. It is vital to the continuation of our industrial stability, our commercial supremacy and our national prosperity. Wastes, however small, may easily become of sufficient magnitude, in their cumulative effect, to endanger the safety of an otherwise going concern.

Classification of Wastes

Wastes divide into two broad classes: preventable and non-preventable. The distinction between these classes is often vague. At best the terms are purely relative, for whether or not a specific waste is avoidable depends on our present knowledge of its causes, its volume, and the economic possibilities for its elimination.

In differentiating between avoidable and unavoidable waste, suppose we illustrate one conception of that difference by a casting for a machined part. It is desired that the material to be removed in producing the finished part be held to the absolute minimum in order that the cost of its removal may also be held to that minimum. Considering the finished part, all the material removed in forming it is waste material. Of that waste material, the portion representing the difference between the minimum casting that will "clean up" properly and the finished piece is the unavoidable portion. Any excess of material in the casting beyond the minimum prescribed is avoidable. Similarly, a labor waste or a machine waste develops. The effort required in removing the minimum material may be defined as useful work, and any effort—by the worker, by the machine, or both—involved in removing the excess metal from overweight castings may be regarded as an avoidable waste of labor, or of machine capacity, or both.

There are numerous other examples of waste which may also be used to illustrate this differentiation. Some are found in every industry, and accepted as "characteristic." They have been so long regarded as an inherent part of the processes employed that little or no attention is paid to them. It is against such indolent acceptance of the "status quo" that this discussion is chiefly directed. There is a steadily growing need for a continuously active program of waste examination and observance as the basis for the corrective action leading to its elimination.

Relative Cost of Waste-Elimination Efforts

The question of relative cost, or effort involved in eliminating waste, governs the application of corrective measures. Fom a theoretical point of view, a waste may warrant any effort tending toward its elimination. Practically, the effort may prove too expensive, and possibly unprofitable with respect to the return it yields. Obviously, careful calculation of costs, and estimates of probable returns must be made at the outset; otherwise the effort and the expense thereof may add to the existing waste, instead of diminishing it. This suggests the need for a continuing evaluation of existing wastes as against the probable cost of their elimination, in order that when the point is reached where the probable returns indicate a profit worth striving for, the necessary corrective action may be started immediately.

How such continuing evaluation shall be carried on, and who shall do it, are questions which can be answered in two ways. One is to instill more deeply into the minds of all concerned, from the president of the corporation to the newest employee on the pay-roll, that a part of the responsibility which each one bears in the main job of getting out the product is to watch closely for all evidences of waste, and to take such steps toward its elimination as are within the power of the observer. This responsibility varies directly with, and in proportion to, the power of position and authority which the individual possesses, for initiating the corrective action.

Yet it is difficult for executives and others under the usual pressure of the day's events to give the careful attention necessary for the economical elimination of wastes. All are usually so occupied with the tasks in hand that it is almost impossible to devote the time to the study of wastes and their causes which scientific elimination requires. It would seem, therefore, advisable in any organization, no matter how small, to dele-

gate to someone well qualified for the work, the duty of constantly analyzing present wastes, determining their volume, and developing the best solution for their elimination. In large organizations, this function might be assigned a specific division, composed of specialists in various lines of work. These men would furnish to the management the facts regarding present wastes, and the estimated costs of their elimination, as well as the estimated savings or profits possible.

The resultant effect of the usual efforts to increase business combined with an aggressive waste-elimination campaign will obviously be to increase the net profits far beyond those obtained, as is often the case, when the "drive for new business" is considered the only worth-while means of increasing revenues. Industry is never so wasteful as when it is most prosperous. Everybody is so busy then getting out the product that wastes are little heeded. This may explain why, sometimes, the percentage of actual return or profit is not as great as anticipated, considering the amount of gross business done in a given period. Because it is human nature to "let details go hang" when we are rushed, there is all the more reason for "tightening up" by starting a waste-elimination campaign coincident with the start of the increased production schedule.

Benefits of Application

The discovery that 17 drops of solder instead of 18 were sufficient to close a can saved an oil company $40,000 a year. The tallest building in the world was built from the profits of 5- and 10-cent sales. The largest private income is credited to a man who made automobiles with less waste of time and material than any other manufacturer.

The success of many gigantic enterprises depends to a large extent upon the faithful carrying out of the most minute details of plans. The difference between success and failure is often that difference between a careful consideration of the small things, and a disregard of these things. Indifference to, or disregard for, wastes, no matter how small they may be, eventually penalizes the producer, the distributor, and the consumer. Never has the truth of the old saying "If you take care of the pennies, the dollars will take care of themselves" been better demonstrated than in waste-elimination work.

Usually the public mind is so much more impressed with restrictions in supplies of commodities, or advances in prices, due to uneconomic conditions, that it does not properly appraise or measure the influence which these economies, these savings of material, or of physical and mental effort have in checking the tendencies toward unstable equilibrium and industrial disruption. More general interest and subsequent inquiry regarding the benefits of applying waste-elimination methods would bring out so many possible economies and advantages that there would result an increasing pressure for their application. The "dollar-urge" in them should stimulate the effort required in the elimination of wastes of every degree. That such interest is not more widely evidenced is more than likely due to the fact that the potential savings or profits in waste elimination are not more generally understood and consequently are not appreciated.

The elimination of waste in natural resources means their conservation—and an obligation which present generations must not overlook is that to future generations. If we do not make wise use of unreplaceable products, and wise provision for the reproduction of replaceable products, both of which mean the elimination of waste, then we are endangering the future welfare, growth, and prosperity of our country. There is no greater possible benefit to be obtained from waste elimination than thus properly to protect our nation's future. In the general field of distribution as distinguished from production, huge savings are possible through the continual effort to make the processes of trade as direct and simple as possible, in order that the consumer may be more readily supplied with the necessaries and comforts of life. The great amount of scientific research now being applied to distribution problems will ultimately yield many benefits, which will be reflected in reduced costs of living and in advance standards of living.

Similarly in the field of industrial relations, there is a steady approach to better understanding among employers, employees, and the public. There may never come a time when strikes will be eliminated, but we may expect to see a consistent reduction in their frequency, their duration, and their intensity.

During the latter half of 1922, 14,691,000 working days were lost, due to strikes in the United States. The total for 16 other leading industrial countries amounted to 5,520,000 days, or about one-third of the time lost in our industries. It is estimated that if this time could have been applied to the extraction of national resources and to manufacturing, we would have added $120,000,000 to our national wealth. Think what this would mean in terms of lower costs of living.

Sources of Waste

Another great waste which we cannot overlook is our annual fire loss, now ranging upward of $500,000,000 per year. The annual fire waste per capita in the United States is eight times as great as Europe's per capita fire loss. Obviously, efforts to reduce this waste will yield some great returns.

There are numerous other examples of wastes of our material and our human resources, but it is not necessary to cite them here. Our point is this: The total loss per year, largely avoidable, is so huge, so tremendous, so staggering in its immensity that we must devote more attention to waste of every sort, and of every degree. Only when we collectively realize what we have lost, what we have missed, what we have been unable to enjoy, because of this huge deduction from our resources, then, and only then, will we start out earnestly to rid ourselves of this huge burden—this gigantic "overhead"—which now so heavily taxes each and every one of us. Conservation of natural resources only remotely appeals to the average individual these days, but if he is shown why he cannot buy the radio set or the motor car he would like to own, he is more

likely to be interested; and also more likely to co-operate in a movement designed to increase the purchasing power of his dollar.

If we accept the premise that the elimination of waste is a responsibility common to all, one which rests on producer, distributor, and consumer alike, then the need for better organization of all forces is still more evident. And yet there are many groups, manufacturers, merchants, consumers, et al., who have not yet shown much interest in waste-elimination work. It is highly desirable that all groups participate and contribute as fully as they can to the early solution of this most pressing problem.

The Survey of Waste in Industry specifically emphasizes the relative responsibilities of management, labor, owners, the public at large, also of trade associations, the government, and all engineers in particular, to co-operate in the elimination of waste. The acceptance of those responsibilities has not been completely demonstrated as yet, although there is a steadily growing recognition of the fact that "something ought to be done." To encourage that interest to the point where more groups say, "We are ready to do our part"—or better still—"We are going forward along this line as rapidly as we can," means a more serious appreciation of what is happening now, and what the future will hold for us all, *if we do not* go ahead.

To hold the pennies of today so close to our eyes that we cannot see the dollars of tomorrow is not in keeping with the business ability and acumen of the American people. Efforts started today toward eliminating wastes will reveal other avenues of approach to the problem. There need be no hesitancy about starting such efforts, because it may appear there is not much to do. The facts are that the more the subject is studied, the more there is found to do. In making the start, something more than resolutions is imperative. No resolve in itself, no matter how good, is worth much until it is vitalized by action. The time to get action is the time when action counts most. The first essential to success is action based on complete information.

Over 50 per cent of the responsibility for wastes in industry rests with management, according to the "Survey of Waste in Industry." "By responsibility," says the Committee, "we do not mean moral responsibility as ordinarily understood; but only that responsibility which arises from the undeniable fact that a given cause of waste can be removed only by a particular agency. We measure responsibility, not by the thing done, but by the opportunities which people have had of knowing better or worse."

The responsibility which rests on employers, employees, engineers—in fact on all our citizens—individually and collectively—is to seek complete information on present wastes. From that point on, the opportunity for corrective action is as great as is the understanding of the magnitude of these wastes, and the heavy toll they take from all of us. Once we are nationally aroused to the great opportunity to make further national, social, and economic progress through waste elimination, we may count on the progressiveness of America's people to "cash in" on that opportunity.

Waste elimination will undoubtedly command more attention in the future than it has in the past, not alone because of the increasing necessity for more intensive study and action to meet the needs of our rapidly increasing population, but because more right thinking along economic lines is becoming increasingly evident. The lessons learned out of the war, and its aftermath, have caused more people to look deeper into the operation of economic laws, and to act in accord with them. The old tendency to wait until something happened and then hastily seek a solution is passing out. The present general attitude indicates a greater willingness to appraise current economic trends, to anticipate their consequences, and to act to avoid the recurrence of depressions and slumps. The main desire now is to keep things going on even keel, to maintain the industrial equilibrium. From such considerations there is bound to arise a broader appreciation of the economic significance of waste as a retarding factor in progress, and as a detraction from permanent prosperity.

Looking Ahead

The emphasis will pass from high prices to high costs, thence to the causes for the latter, and thence to the wastes which are responsible for excessive costs. Greater recognition will also be given the fact that reduction of wages does not necessarily mean lower production costs, and that higher wages, rather than lower, are more likely to lead to that result. For high wages are usually based on high productivity, brought about by the adoption of improved methods, greater efficiency on the part of capital, and also greater efficiency and increased output on the part of the worker. Through the elimination of waste, conditions are created which make it possible for the worker to increase his productive capacity and thus increase his purchasing power. Increased production per unit, as the result of waste elimination, means lower costs, lower prices, followed by increased consumption, rising standards of living, steady employment, and sustained purchasing power.

As this becomes more generally accepted and applied, we may confidently expect to see waste elimination more widely recognized as a fundamental of business management. In some cases, only one or two of the methods herein discussed may be applicable; in others, all of the methods may be applied either simultaneously or in sequence. In either instance, the effort will be made, not alone from the standpoint of its possibilities as a source of greater profit, but also from the acceptance of the fact that the elimination of waste is the well-spring of permanent prosperity. Only through the elimination of waste in present materials, processes and products is it possible to create those surpluses which make it possible for nations, as well as individuals, to advance and progress. Such surpluses or savings are the product of better organized effort and of better practice in the elimination of waste. The difference between our actual savings and those possible through more intensive application of all waste-elimination methods may be used as the index of our economic progress. The smaller that difference, the higher will be our living standards.

Hood Rubber Sales Budgets

A Plan That Assures Profitable Operation of the Selling Organization

By K. W. STILLMAN

Associate Editor, MANAGEMENT AND ADMINISTRATION

A BUDGET plan, to be effective, must be simple in design and operation to facilitate determination of the various quotas, and must also be so arranged that both responsibility and accountability for failure to meet budget allowances can be definitely assigned to an individual department or manager.

The Hood Rubber Products Company, which is the marketing organization for Hood products, has developed a budget plan along these lines, that has brought them quite satisfactory results. Their plan is based upon predetermination of the ratio of selling expense to sales volume that will permit profitable operation, setting up a ratio in the budget that will permit a profit to be gained, and then making sure, by close follow-up of subsequent activities, that this budgetary estimate is met. Their experience shows that such a plan can be operated to show a variation of only ½ of 1 per cent in this ratio of sales expense to sales volume between budget figures and actual figures compiled at the close of the fiscal year.

Their first step in preparing the budget is to obtain an estimate of sales for the budget period. This estimate is based upon estimates made by each salesman operating from branch offices, located in practically all large cities of the country, combined with estimates of sales to jobbers and of export sales.

Each salesman is furnished with a complete list of dealer customers, whether actual or prospective, in his territory. With the name and address of each actual customer is given, in case units by lines of product sold, the amount of goods he has purchased during each of the five previous years. Regarding prospective customers, information furnished by the salesman in his reports and that obtained from other sources are shown, which will facilitate determination of his potential value as a customer during the next budget period.

Adding to the information shown in this "key-book," so called, his own knowledge of each customer's business, the salesman estimates the amount of each kind of goods he expects to sell. Breaking the salesman's estimate down into units per customer, the total estimate is considered to be more accurate than can be obtained by other ways. More exact information is available for estimating each dealer's business individually than for making a lump sum estimate for the whole territory. Also, since the territorial estimate is the sum of several hundred dealer estimates, individual errors tend to compensate one another.

Each salesman's estimate is turned in to his branch office, where it is reviewed and, possibly, revised by the branch manager in the light of his better knowledge of the size of the territory, number of towns and dealers in it, past per-capita business, general business conditions, and other influencing factors. Each branch office totals the estimates made by its salesmen and turns the sum in to the home office. Here again the estimates are reviewed and, if revisions are necessary, they are worked out with the advice of the manager of branches at the home office so that the final estimate, or branch sales quota, is satisfactory to all.

The next step is to determine the expense necessary to sell the volume estimated. This determination is made possible by an accounting method which allocates, definitely and exactly, every item of expense to the functional department or responsibility that incurs the expense. All sales expenses are classified as per cent or variable expenses, i.e., those which vary with volume of sales, such as freight and commissions; and overhead or fixed expenses, i.e., those which have no relation to or are only indirectly connected with sales volume, such as rent, insurance, and taxes.

Variable expenses for each branch are determined

ORGANIZATION UNIT_____ **LEDGER A/C**_____

Items		Explanation		Amount	%of Sales
Trade Discount					
Discount Expense					
Special Discount					
Cash Discount					
Selling Expense					
Salaries					
Traveling Expenses					
Commissions					

Items		Explanation		Amount	%of Sales
Troubles Expense					
Adjustments					
Application					
Bad Debts					
Collection Expense					
Dead Stock					
Job Loss					
Ret'd Mdse. Poor					
Profit and Loss					

FIG. 1 WORKING SHEET USED IN DETERMINING EXPENSE ITEMS

each year by a study of past experience and a knowledge of present conditions that permits a reasonably accurate forecast of future conditions. For instance, from past records it is possible to learn what percentage of list sales price has been used in trade discounts; knowledge of present conditions permits a logical decision as to whether this percentage will be sufficient for the ensuing year, whether it should be increased or whether it will be possible to lower it.

Using a working sheet similar to that shown in Fig. 1, each item of variable expense is studied in this manner and a figure determined for each branch which represents the percentage of list sales required to take care of that item. Then this figure multiplied by the branch sales quota gives the dollar expense for each item.

Items of fixed expense are evaluated for each branch by job analysis and time studies. As an example, the Hood Company has analyzed the floor space needed to handle each case of merchandise sold, the amount of business one clerk can handle, the amount of stock one man can pack and ship, etc. These figures are compiled each year, inasmuch as changing conditions, changing prices, and other factors tend to alter all these expense items. With these basic figures established, it is possible to estimate closely just what each item of fixed expense will amount to in the branch operations.

For determining the share of home-office fixed expense that should be borne by each branch, a working

TABLE 1. FICTITIOUS EXAMPLE OF METHOD USED TO DETERMINE FIXED EXPENSES AND PROFITABLE SALES QUOTA

Branch sales quota—list price	$1,000,000
Branch variable expense—10% of list price	$ 100,000
Branch fixed expense	30,000
Total branch expense	$ 130,000
Pro-rata home office variable expense—5% of list price	50,000
Pro-rata home office fixed expense	45,000
Total variable expense and fixed expense	$ 225,000
Summary fixed expenses:	
Branch fixed expense	$ 30,000
Pro-rata home office	45,000
Total fixed expense	$ 75,000
Summary variable expense—% of list price:	**Per Cent**
Branch variable expense	10
Home office variable expense	05
Total variable expense	15
Cost merchandise	80
Total variable cost	95
Contribution	05
	100

$75,000 ÷ 0.05 = $1,500,000 "Break-even" sales volume

sheet like Fig. 2 is used. Columns on this sheet show estimated sales volume; per cent of total; three columns of departmental operating expenses that have been determined by the same methods of job analysis and time studies as were used in finding branch office fixed expense items; and total columns.

The first line gives total figures for footwear and tires. This particular sheet being used to determine expense of tire sales, the next line gives the proportion of sales and expense charged to tires. The next five lines give proportions of total tire sales and expense to be allocated to the types of sales outlet used. The rest of the sheet subdivides the total "stores" figures into amounts apportioned to each store. All of these subdivisions are made on a basis of sales volume.

After all expense items are determined, the next step is to make sure that the sales estimate made by each branch is sufficient to make its operation profitable.

PRO - RATA OF FIXED EXPENSES

TIRE

	Volumes	Per Cents	Mgr. Dist. " Sales Accts. " Credits	Mgr. Sales Inf. " Mdse. " Adv. " Tire Sales	Mgr. Tire Stores	Direct Fixed	Total Fixed
Total Foot & Tires	50,000,000	100	20,000				
Total Tire	20,000,000	40	8,000				
Jobbers	4,000,000	20	1,600				
2nds. Trade Disc.	2,000,000	10	800				
Spec. Jobs Trade Disc.	2,000,000	10	800				
Export	2,000,000	10	800				
STORES	10,000,000	50	4,000		TOTAL FOR STORES		
Atlanta	500,000	050	200				
Chicago	2,000,000	200	800				
Cleveland	500,000	050	200				
Dallas	500,000	050	200				
Des Moines	250,000	025	100				
Grand Rapids	250,000	025	100				
Kansas City	300,000	030	120				
Los Angeles	700,000	070	280				
Minneapolis	250,000	025	100				
Pittsburgh	300,000	030	120				
New England	500,000	050	200				
New York	2,000,000	200	800				
San Francisco	750,000	075	300				
Seattle	500,000	050	200				
Washington	700,000	070	280				
		1000					

FIG. 2 WORKING SHEET FOR PRO-RATING FIXED EXPENSES
(Fictitious figures show method of use)

Suppose that a branch sales estimate in units when valued at list prices becomes $1,000,000 (see Table 1), and suppose that the sum of all variable expense items for the branch as computed in Fig. 1 is 10 per cent, i e., 10 cents of each dollar of sales is required to pay freight, commissions, discounts and other items of variable expense. Suppose that the total fixed expenses for the branch amount to $30,000 (Fig. 1). Suppose fixed expense for the home office, prorated according to sales volume (Fig. 2), adds $45,000 to branch expenses, and suppose variable expense for the home office, prorated according to sales volume, adds 5 per cent of $1,000,000 or $50,000, thus making a total of $225,000 expense for $1,000,000 sales (see Table 1.)

The two items of fixed expense amount to $75,000, and this sum is the determining factor in profitable operation since, theoretically at least, when no sales are made no variable expense is incurred. Branch variable expense is 10 per cent; branch share of home-office variable expense is 5 per cent; then if the cost of merchandise to branch is 80 per cent of list price, these

items would total 95 per cent of list sales, leaving 5 per cent as the contribution the branch could make against its fixed expenses of $75,000. This latter sum divided by .05 gives $1,500,000 as the volume of sales necessary before the branch could pay all its expenses and begin to make a profit.

In this fictitious example it is evident that the branch must either increase its sales quota from $1,000,000 to something over $1,500,000, or reduce its cost of operation. Otherwise its activities would be conducted at a loss.

Calculations similar to the one described are made for each branch estimate. These not only determine the amount of sales necessary to pay expenses but predetermine the amount of profit to be obtained if the

BRANCH OPERATION REPORT

Branch X Y Z
Division A B C
July 1925

Accounts	Years Operation Budget List Sales 1,000,000 Year	1/12	%toList	Current Month List Sales 85,000 Amount	%toList	Months to Date List Sales 344,652 Amount	%toList	Average 1/4 List Sales 86,163 Amount
Disc. Exp. Trade	30,000	2,500.00	03000	2412.12	028	9876.50	029	2469.13
Special	10,000	833.33	01000	831.14	010	3321.63	.010	830.41
Cash								
Sell. Exp. Salaries								
Traveling								
Commissions								
Sales Prom. Exp.	2,000	166.67	00200	168.50	002			
Freight, Exp. P. P.	10,000	833.33	01000	832.29	010			
Liab Insurance								
Troubles Exp. Adjustments	10,000	833.33	01000	837.46	010			
Application								
Bad Debts.								
Collection Exp.								
Profit & Loss								
Total % Exp.(Variable)	100,000	8333.34	.1000					
Overhead Accounting Sal.	5,000	416.66						
Insurance								
Office Expense								
Rental Expenses	8,000	666.67						
Shipping Expense								
Shipping Wages								
Taxes								
Tel. & Tel.								
Total Overhead (Fixed)	50,000	4,333.33	.0500					
Total Cost	150,000	12,500.00	.1500					
Summary Net Sales								
Disc Exp.								
Selling Exp.								
Troubles Exp.								
Total % Exp								
Total Overhead								
Total Cost								

FIG. 3 MONTHLY REPORT SHEET FOR CONTROLLING OPERATION
(Fictitious figures show method of use)

branch meets its budget estimates. After the "break-even" point has been reached in sales volume and all fixed expenses cared for, the percentage of "contribution" becomes profit on all additional sales. If, in the case cited before, the sales quota had been $2,000,000 and expenses remained the same, the "break-even" point would have been reached at $1,500,000, as before. Contribution of 5 per cent on all sales from the break-even point to sales quota would have been profit, so that it could be stated definitely that, if the branch realized its budget estimates, it would operate with a profit of $25,000.

The final step, and a most important one, in budgeting procedure is to make sure that, after budget estimates are made as accurately as possible, they are realized in actual operation. The plan used by the Hood Rubber Products Company permits very close control of this part of the work.

The major item in their control is an operation report (see Fig. 3), which is issued monthly to each branch manager and all other departmental managers whose responsibilities have been recognized in the formulation of the budget. On this sheet are given the amounts budgeted against each item of expense, the monthly figure representing this yearly total, and the per cent to list price of the branch sales quota each item represents.

At the end of each month the report is made out at the home office to show how that month's operation compares with standard as set up by the budget, and what the year's average is. By this method, both the home office and the branches are able to follow very closely the fluctuations from budget set-ups, to determine accurately where and why such fluctuations occur, and immediately to take the steps necessary to eliminate any unfavorable variations.

Since the amount of stock carried by the branch offices and their practice in collecting bills have a decided effect upon their profits these items are also controlled by a form on the back of the operation report shown in Fig. 4.

From past records and from study of conditions under which each branch operates, such as its distance

STOCK AND RECEIVABLES

Month	STOCK % Sales Standard	STOCK Actual	RECEIVABLES % Sales Standard	RECEIVABLES Actual
April				
May				
June				
July				
August				
September				
October				
November				
December				
January				
February				
March				
Total				

FIG. 4 BACK OF OPERATION REPORT USED TO CONTROL STOCK AND RECEIVABLES

from the home office, traffic conditions and rates, and similar factors, an average stock figure is determined which will permit the branch to obtain greatest possible turnover consonant with meeting all its delivery requirements. Because sales of the product are highly seasonal, this factor must be considered in deciding the amount of stock the branch needs in any particular month to conduct its business.

In the same way a study of the terms of payment given to customers, in relation to community practice, to terms of competitors, etc., gives a figure which represents the proportion of list sales that appears necessary to have tied up in receivables.

Each month the branch managers are shown, by the operating report, how their actual conditions at the close of the preceding month compared with these standards, and, if they are below standard, can take immediate steps to remedy the condition.

Equally close control is maintained over sales. As previously described, each salesman estimated the quantity of goods he will sell each dealer in his territory. These estimates are placed on sheets opposite dealers' names, and each sale made is entered on the sheet in the same terms—units of product—as was used for making the estimates. Copies of these sheets at the home and branch offices permit his superiors to give the salesman every assistance in selling his full quota.

If the salesman estimated that he could sell Dealer A of Anytown 5 cases of men's canvas shoes and, near the close of the buying season, the branch manager sees that none have been sold to Dealer A, he can take definite steps to learn the reason for the apparent failure and to aid the salesman in obtaining an order.

The fundamental principle of this budget plan is very simple. The company realized that some expense items vary with sales volume while others remain fixed. They know that these fixed expenses must be met before they can make a profit. Their whole plan, then, becomes an exact determination of these expense items and the sales volume required to meet them, setting up a sales quota that will assure profitable operation, and making its predictions come true.

As stated at the beginning of this article, this plan has operated to the satisfaction of the Hood Rubber Products Company. They have been able to predetermine their sales, the expense of making those sales, and their operating profits with a considerable degree of accuracy. No doubt there are many features of this plan which other concerns could adopt advantageously in their own work.

The Abuse of Cement Floors by Metal Truck Wheels*

IT is a well-demonstrated fact that the use of metal wheels on trucks operated over cement floors is very damaging to the floors and shortens their effective life considerably. This fact has been demonstrated in plants where cement floors have quickly broken down under metal-wheeled truck traffic and by tests to determine the destructive properties of various types of truck wheels. An objection frequently made to the use of rubber-tired or composition truck wheels is that the more elastic wheel requires more power to move it. To determine the truth of this objection comparative tests of five types of wheels, 8 in. in diameter, were made to learn draw bar pulls necessary to start and sustain motion under three loading conditions.

Types of wheel used were: (1) Ordinary cast-iron wheel made by the Fairbanks Co.; (2) a wheel composed of a series of hickory blocks held between steel plates made by Divine Bros.; (3) composition wheel of heavy fiber sheets pressed and riveted together, made by the Lansing Co.; (4) a wheel which uses especially woven cotton duck as the shock-absorbing tire, made by Divine Bros., and (5) an ordinary rubber-tired wheel made by George P. Clark Co. Table 1 gives the results of these tests under light, medium, and heavy load.

The use of roller bearings indicated an average saving in draw bar pull to start motion of nearly 40 per cent and about 44 per cent to maintain motion. This means that a truckman can handle with the same effort nearly twice as heavy a load if ball or roller bearings are installed in the wheels of his truck.

To get some indication of the relative amount of floor abrasion caused by the various types of wheels, a 96-hr. test was made, during which each wheel, carrying a 300-lb. load, was revolved in its own track on a cement floor. Using percentages for the purpose of comparison the indication of floor abrasion was: Cast-iron wheel 100 per cent; Divine wooden wheel 45; fiber wheel 30; Divine canvas wheel 20; rubber-tired wheel 5.

An examination of the wheels themselves after this test showed the diameter of the cast-iron wheel had decreased $\frac{3}{64}$ in.; the wooden wheel's diameter had decreased $\frac{5}{16}$ in., and it had developed flat spots; the fiber wheel had decreased $\frac{3}{16}$ in. in diameter; the canvas wheel's diameter had decreased $\frac{3}{32}$ in.; and the rubber-tired wheel had decreased about $\frac{1}{16}$ in.

TABLE 1. RESULTS OF TEST

Draw bar pull required to start and to sustain motion at slow walking gait with four wheel truck loaded with 300 lb., 500 lb. and 900 lb. when equipped with wheels of different types. This test was made at the New York shop of the Turner Construction Company.

Type of Wheel	Light—300 Lb.		Medium—500 Lb.		Heavy—900 Lb.	
	Start	Sustain	Start	Sustain	Start	Sustain
1. Cast-iron	11.6	10.8	22.8	20.5	33.1	27.7
2. Divine No-Kut	10.7	9.8	16.9	15.5	28.6	26.2
3. Fiber	9.0	8.4	13.3	12.2	24.9	22.2
4. Divine canvas	13.6	12.9	20.4	18.7	34.3	32.0
5. Rubber-tired	12.7	12.5	22.9	21.7	43.7	42.5

* Abstracted from The Turner Constructor, March 1925.

Better Shipping Containers

Up-to-Date Practice in Internal Packing and Strapping

By FLOYD T. SMITH

Industrial Department, General Electric Company

THE term "internal packing" pertains to the method of using lining, wrapping, and padding. Material is that which is used within a container as protection against weather and climatic conditions, or to minimize the effects of blows and shocks in handling.

The following list covers the several types of internal packing material in common use:

Excelsior	Sea grass	Waterproof paper
Paper trimmings	Shavings	Bogus paper
Hay	Saw dust	Corrugated fiber board
Straw	Felt	

Excelsior is probably the most common of all internal packing. However, for some service it does not have sufficient rigidity to prevent the sides of a fiber box from crushing while stored in a warehouse, and if kept there very long, especially near steam pipes, it gradually loses its elasticity on account of contraction and dryness.

FIG. 1 X-RAY TUBE BOXING

Paper trimmings, which are cheap, are used for many commodities. Large wholesale houses use paper trimmings almost exclusively for internal packing because this is available in large quantities as trimmings from catalogues, books, wrappings, and similar sources.

Hay, straw and sea grass are used in large quantities for packing glassware, dishes, porcelain, and other fragile articles. The long stalks and construction of sea grass makes it adaptable for wrapping, and yet it holds its useful elasticity when the container is completely packed. These materials are, however, susceptible to moisture and dampness, and for this reason are not used where such conditions are prevalent.

Saw dust, usually of a coarse grade, is the cheapest internal packing. It is particularly useful for packing many small parts which do not require individual wrappings. It has the disadvantage, however, of compressing under repeated handling, leaving space in the container which often allows the article to go to the bottom of the box.

Felt packing is expensive and is used only where special care is necessary to hold articles rigidly in position or to prevent finished surfaces or delicate parts from being marred.

The several forms of paper mentioned are used mostly as a protection against moisture and dirt. Even though the material is proof against damage by moisture, it is often desirable to line the container, since this makes it possible for the material to arrive in clean condition and with a new appearance. This lining material should be strong so that it will not tear because of shrinkage of the container. It should not be fastened to the container.

Internal wooden cleats firmly brace the article in the container and securely hold it in a fixed position. Cross partitions which also provide protection to the contents may be either lateral or longitudinal and should usually be fixed in position by nailing. This method prevents the contents from surging when the container gets a severe jar or jolt.

Partitions are used in boxes of many styles, both wood and fiber, to separate fragile articles. Fiber partitions are half slotted so as to fix the dimensions of the cells and to hold the contents in an upright position. Often, as in the case of the egg crate, the small separate compartments are replaced by molded cuplike indentations which give additional protection. Internal compartments in bottle crates are formed by either metal or wooden partitions.

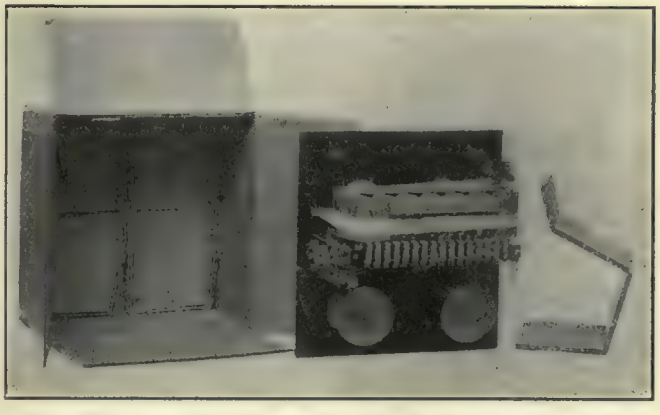

FIG. 2 DOMESTIC PACKING, SUPER-HETERODYNE PANEL

If more than one tier of partitions is to be used in the container, pads are inserted between the tiers to separate them and thus completely enclose the contents of each cell. Pads are also often placed next to the

top and bottom of the box so as to line it partially and to add resiliency to its interior surface. The four sides of the box are often similarly reinforced with flat sheets of board, scored so as to fit the interior of the box and to envelop its contents. Fruits and fragile articles shipped in barrels are often protected by corrugated pads and linings. The use of a disc or cushion in the ends of apple barrels is a very general practice.

Another method of internal packing which is frequently employed is the "unit carton" system. Articles such as electric irons, lamp fixtures, etc., are placed in individual cartons which also contain the necessary accessories. A number of these are then shipped in a container, so designed that the contents exactly fill the box. The advantages of this system are that breakage is practically eliminated, the goods are received by the retailer in an attractive condition for displaying on his shelves, and the customer receives the article and its accessory fittings in a convenient package.

Packing for Export

Factors which have to be taken into consideration in deciding upon the proper method of packing for export include:

- Shipping facilities
- Port facilities
- Climate
- Customs laws
- Customer's requirements
- Character of commodity to be shipped
- Regulations of transportation companies
- Protection necessary against loss and damage
- The cost of the package
- Freight handling and transportation facilities in country of destination

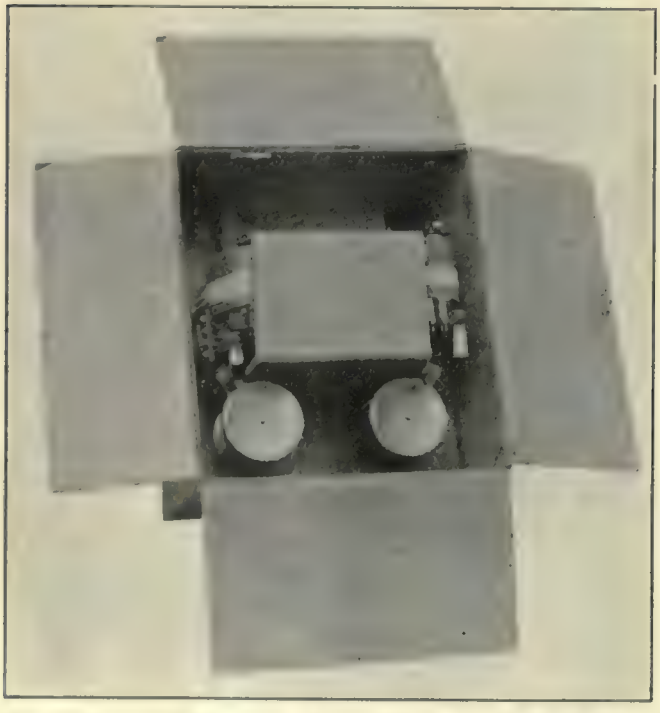

FIG. 3 DOMESTIC PACKING. PANEL IS SECURELY HELD WHEN COVER IS CLOSED AND SEALED

Liquids are usually shipped in airtight containers, such as barrels, drums, cans, or bottles. Small articles such as bolts, nuts, rivets, and nails are usually shipped in completely closed wood containers to prevent loss during transportation. Machinery is in some cases shipped in open, and in others in completely closed crates.

A higher duty is often required for a container used for display boxes. For such cases the material and container should be packed separately, or in separate compartments of the same shipping case, and invoiced as separate items.

Invoicing and marking are included among the varying requirements of countries to which goods are shipped. Consideration for customer's requirements includes sending instructions for assembly, packing assortments desired, shipping all parts by the same boat, etc.

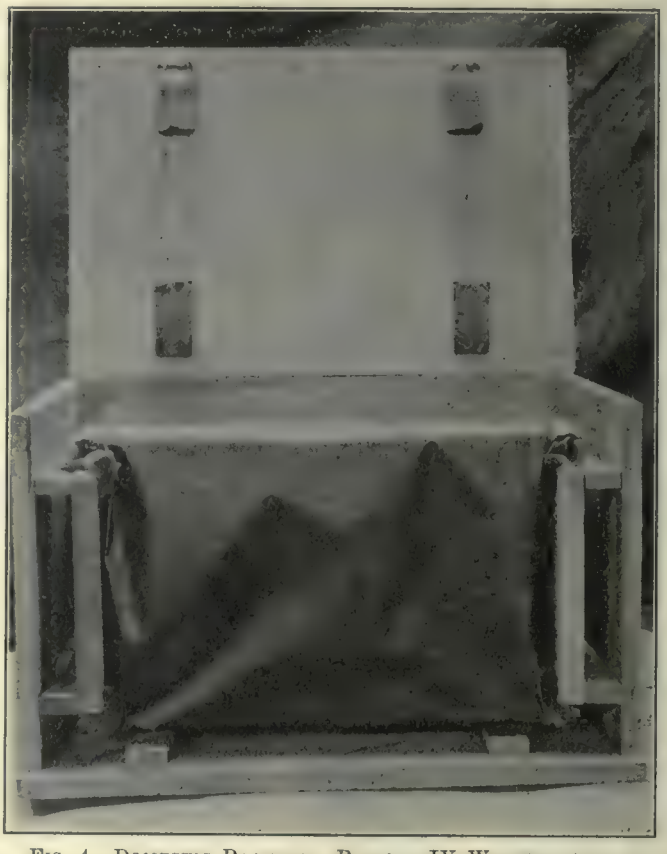

FIG. 4 DOMESTIC PACKING. RADIOLA IV WRAPPED AND IN POSITION IN CASE

Transportation facilities in the interior of foreign countries are often primitive and may involve packing on backs of animals. Stout containers, special provision for lashing to sleds, special protection for fragile objects, and lighter weight packages may need consideration. Climatic conditions, such as rainy seasons, excessive dampness, and excessive heat or cold, furnish a problem in deciding which is the proper packing to be used. In the case of poor harbors, commodities must be unloaded from ships to lighters. Poor storage facilities mean that consignments must lie in the open, with no protection from moisture, heat, or cold.

In completely boxed machinery, under certain conditions, dampness condenses on the cold machinery.

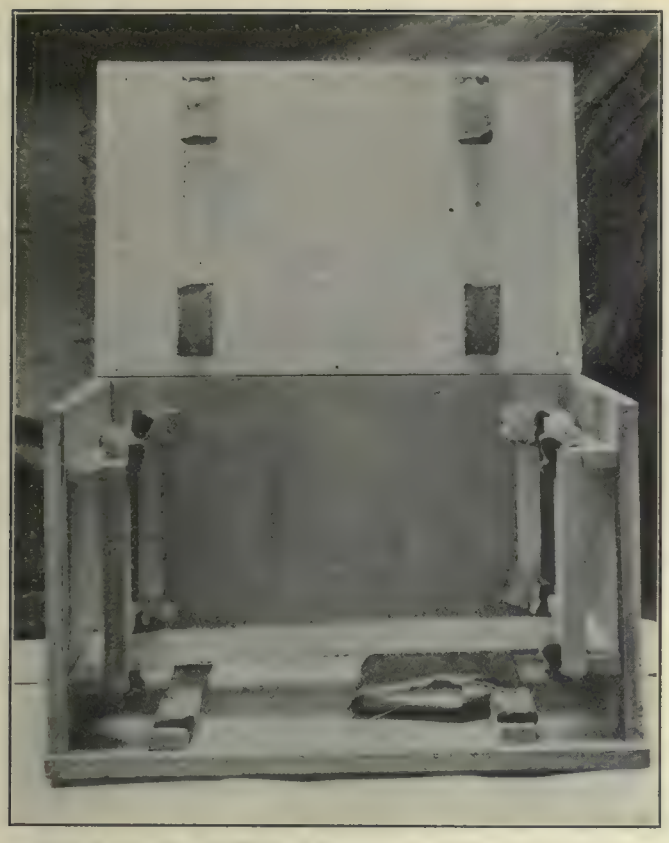

FIG. 5 CASE WITH FRONT REMOVED TO SHOW CRADLE AND FELT CUSHION

This condensation, if allowed to continue, may prove detrimental. There is a difference of opinion as to whether it is advisable to ship in completely and hermetically sealed containers or in containers that are furnished with openings to permit "breathing." If openings are used, they should be provided with netting to exclude rats and mice.

A complete zinc lining is often used as a protection against rust. Pitch-covered canvas or tar-coated building paper serve as very good protection against moisture. The pitch-covered canvas is self-sealing, is tough, will not crack from cold, and is rendered more flexible by heat. This flexibility prevents it from being punctured. Boxes are often lined with waterproof paper and the tops covered with tarred felt fastened down on the sides and ends. All joints are sealed with cement and the exteriors are given two coats of paint. Metal parts are protected by lubricants and neutral slushing compound to prevent rust and to resist the action of sea air and salt water. Bright brass, copper or nickeled parts can be protected by wrapping securely with soft paper, free from sulphite. Instruments are sometimes coated with paraffine and packed in airtight tin boxes. Coal tar, often used to cover the cases of goods consigned to India, protects against the action of the termite, a small wood-eating insect.

The General Engineer Depot, Washington, D. C., has developed a list of recommended specifications for export containers which will be valuable to all exporters.

Many ingenious methods are used to give strength to containers and to protect them, while in transit or storage, from pilfering. One of the cheapest and quickest methods of adding to the strength of a wooden box is to strap it with a thin, flat metal band. This band, if of proper quality and if properly put on, will arrest many shocks which otherwise would be imparted to the nailing of the box. The band must not be put directly over the nails but toward the center of the box. The banding should be enameled to prevent it from rusting, and unannealed for strength and to prevent it from stretching. It should be drawn very tight with a simple tightening device and nailed, spacing the nails 4 to 6 in. apart, using care that the nails do not extend through and injure the contents.

Straps are used on boxes of ½ in. lumber; on boxes of thinner material it is necessary to join the ends, and therefore the braided, twisted, single- and double-strand round wire is used. The binding wires are stapled to the sides, top and bottom and, when the container is closed, the ends are twisted together. Wire-bound containers also have commercial advantages because they can be readily opened, refilled, and used again.

Sealing

A gummed tape bearing the trade-mark makes a good seal for fiber boxes and also has advertising value. The thief hesitates to tamper with tape he cannot replace. Fiber boxes are often furnished with a metal eyelet in the lid flap. This fits over a plug riveted in the box end. To open the box, either the seal must be destroyed or the box cut open. Collapsible bags with wide laps, having a cord threaded through the ends at the bottom and crossing over the top, are sealed with marked leaded seals. Canvas bags containing as much as 200 lb. are sealed with spiked leaded seals.

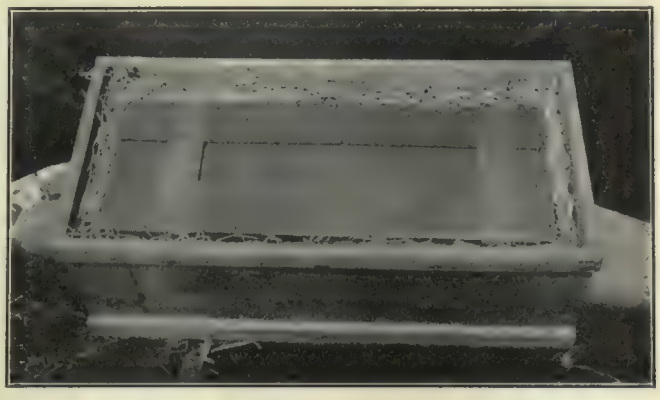

FIG. 6 DOMESTIC PACKING. RADIOLA SUPER-HETERODYNE ENCLOSED IN FIBER BOARD INNER CONTAINER FLOATED IN EXCELSIOR IN THREE-PLY VENEER OUTER CONTAINER

Marking

Many methods of marking shipments are used, but the plainest and most comprehensive is always the best. Such markings as "This side up," "Handle with care," "Fragile," "Glass," "Top," "Use no hooks," "Breakable," "Perishable," "Do not crush" and "Do not

drop'' call attention to the care which should be exercised in handling a container. Many packages and containers with valuable merchandise are very poorly marked. Identification tags are often insecurely or carelessly fastened to the container and soon become detached, leaving the container without marking.

Often the names of the manufacturer and the commodity are printed very plainly on the container while it is being constructed.

A printed label pasted on a package indicates clearly the contents, and a similar printed label, on which the shipping instructions can be plainly marked, serves as a very good means of identification. One of the best and most satisfactory markings is a stencil with black waterproof ink.

The size of the stencil letters should correspond to the size of the container. For marking on export shipments, metal dies are used to accomplish practically the same result as branding, and this method is quicker, cheaper and at the same time eliminates the fire risk. After being coated with ink, the die is driven into the wood of the box with a hammer. On comparatively large containers the case number and shipping address, and only this marking, should be put on two sides. However, on very large cases, which must be handled with lifting devices, it is permissible to show slinging positions and the center of gravity by center lines. Elsewhere on the case, preferably on the ends, may be shown the order number, the gross weight, the net weight, the measurement of the case, etc. If for foreign shipment, the port marking should always be made to stand out boldly in large figures and letters.

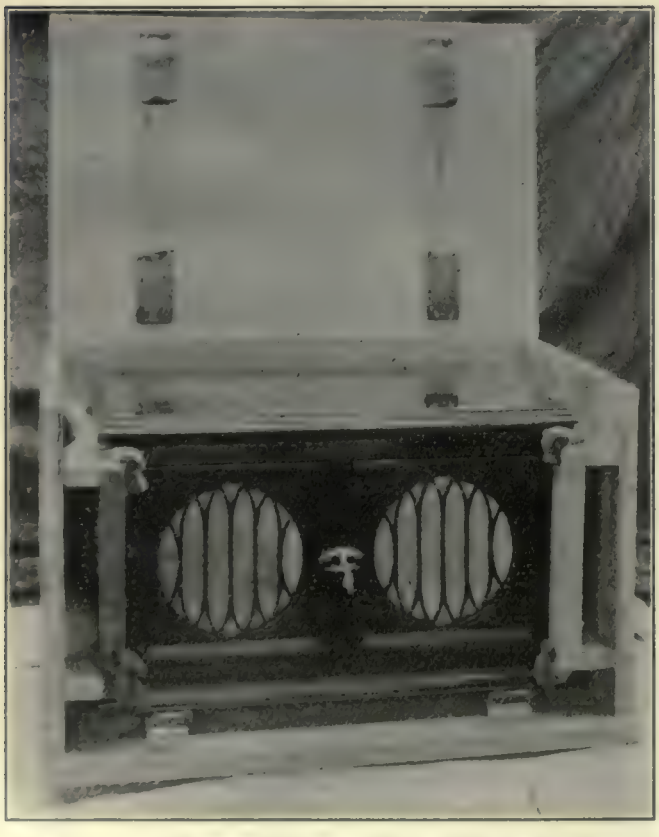

FIG. 7 DOMESTIC PACKING. FRONT OF CASE REMOVED TO SHOW RELATION OF INSTRUMENT TO CUSHIONING

Transportation companies can handle the fully described shipment better. Truckmen can more effectively handle the consignment if the packages are fully identified. Marking on each package the total number in the consignment assists the truckman in judging the size of the consignment and furnishes a means of keeping the consignment intact; the receiving office of the purchaser can make an accurate check; and the tracer can be notified about stray containers. Invoices paid in error can be corrected if packages are identified by a serial case number on the package and if the packing list is so prepared that it indicates the number of the case in which each component part has been packed. Consignments received can be forwarded in original packages without opening at distributing points.

The suggestions below for the careful marking of containers are condensed from the Consolidation Freight Classification #4.

FIG. 8 CABINET FOR RADIOLA SUPER-HETERODYNE IN OUTER CONTAINER

Marking Specified: Each package, bundle or loose piece of freight must be plainly, legibly and durably marked by brush, stencil, marking crayon (not chalk), rubber type, metal type, pasted label (securely attached with glue or equally good adhesive), tags, or other equally good method showing the name of only one consignee, and of only one station, town or city and state to which destined. When consigned to a place of which there are two or more of the same name in the same state, the name of the county must also be shown. When consigned to a place not located on the line of a carrier, it must also be marked with the name of the station at which consignee will accept delivery. When consigned to "order" it must be so marked and further marked with an identifying symbol or number, which must be shown on shipping order and bill of lading.

Freight Exempt from Marking: A shipment that fully occupies the visible capacity of a car, or that weighs 24,000 pounds or more, when shipped from one station, in or on one car, in one day, by one shipper for delivery to one consignee at one destination, need not be marked.

Comparing Marks with Shipping Order or Bill of Lading: The marks on bundles, packages or pieces must be compared with the shipping order or bill of lading, and corrections, if necessary, made by the shipper or his representative before receipt is signed.

Old Marks to Be Removed. Old consignment marks must be removed or effaced.

Freight in Excess of Full Cars to Be Marked: Freight in excess of full cars must be marked as required for less freight than carload freight.

Material Handling for High Speed, Straight-Line Flow of Work

Meeting Newspaper Manufacturing Requirements

By MARK WAYMAN

Mechanical Superintendent, San Francisco Chronicle

STRAIGHT-LINE production and the application of improved material-handling methods are outstanding features in the new plant of *The San Francisco Chronicle*, the first great building west of Chicago to be designed for newspaper production on modern factory principles. Like most of the newer buildings devoted to the newspaper industry, the plant was designed with as few floors as possible (three and a basement). The products of each operation are routed in a direct line to the next process to save time and motions. Wherever practicable, gravity flow is used up to the point of finally delivering the papers to the trucks and mail wagons.

The building, 265 x 160 ft., which covers a whole block, is of reinforced concrete, well lighted and effectively ventilated. It typifies the principle that an industrial plant can be made beautiful as well as highly efficient from a production standpoint. The architecture is Gothic in design, a type which lends itself readily to good lighting and to all the demands of a manufacturing plant where something more than mere utility is desirable. A view of the lobby is shown in Fig. 1.

FIG. 1 GOTHIC DESIGN IN LOBBY OF NEW BUILDING

On the third floor most of the operating departments are located. These comprise the editorial and the advertising departments, composing, make-up, stereotyping, photographic, engraving, and art rooms, a library and telegraph room. The second floor is devoted to the shipping and mailing of newspapers. All the press work is done on the first floor, and in the basement are located the storerooms, used mainly to hold the reserve stock of paper.

Throughout the entire building all ceilings are composed of sound-absorbing material. The noise of typewriters in the editorial and advertising departments, the linotype machines in the composing room and the presses in the printing department, is thus deadened instead of being reflected as would be the case with ordinary plaster, metal, or wood.

The layout of the third floor was arranged with the idea of establishing straight-line production. The reporters' section and the editorial offices occupy one entire 265 ft. side of this floor. Across one end of the building is the advertising department, and across the other end is the stereotype department, next to which are the art room and engraving department. Adjacent to the editorial department is the telegraph room and a library for books and files of newspapers and clippings. The remainder of the floor is occupied by the composing room, thus flanked on three sides by departments with which it has direct dealings. The fourth side of the composing room looks out upon the street.

Fig. 2 shows a semi-circular, or horse-shoe, arrangement of desks for copy-readers in the editorial department. This arrangement gives each of the 10 readers sufficient room, but conserves space. It also brings all of them within easy reach of a pneumatic tube through which copy goes to the composing room.

In the composing room there are two banks of linotype machines along the side by the windows, and two banks along the opposite side of the room. (See Fig. 3.) The copy cutter, who supplies manuscript to the operators, sits at a desk between these sets of machines, so located as to necessitate the least amount of walking (in no case no more than 30 ft.) for the oper-

FIG. 2 COPY-READERS' DESK AND PNEUMATIC CONVEYOR TUBE

ators. Manuscript is sent to the copy cutter from the editorial room through the pneumatic tube previously mentioned. A zinc-covered table by his desk is the "dump" where the compositors deliver the type they have set and get new copy.

Starting at this point and extending down the center of the room to the stereotyping department are the make-up tables. These make-up tables are located conveniently also with respect to the advertising copy "dump" along the northern side of the room. On them the news type, cuts and advertising set-ups are made into forms as pages ready for stereotyping. Seventy-two pages can be laid out at one time. Fig. 4 is a view in the make-up department.

From the make-up tables trucks containing the forms pass through a doorway to the molding tables in the stereotyping room, and after being unloaded are brought back up into the make-up department through another doorway.

Thus, editorial copy comes directly into the composing room, and the type is set up, made into forms, and delivered for stereotyping, by the shortest route, almost in a direct line. Likewise, advertising copy comes directly in at one end of the composing room, is set and made up, and then is sent for stereotyping, all processes following straight-line production.

From the steam table in the stereotyping department the mats go directly to the trimmers and then to the autoplates in the center of the room. From this point they are sent to the shaving machine, and then are ready, as semicylindrical plates, for delivery to the press room on the first floor.

A combined elevator and conveyor system is installed to take the stereotype plates down to the press room. The elevator is located alongside of the shaving machine. Plates are placed on it and are delivered at their destination in something less than 100 seconds afterward, without further handling. The elevator is 42 ft. high and its platform consists of a short section of gravity rolls, hinged in the center, so that when it reaches its lowest position it will automatically tilt and deliver the plates to the horizontal conveyor.

The conveyor is made up of rollers which are driven by a 10 in. belt. The plate is semicylindrical and straddles this belt, traveling on the rollers. Along each side of the belt angle irons are located to guide the plate and keep it off the belt. The conveyor is 138 ft. long. Belt travel is 165 ft. per min., and the plates themselves move over the rollers at the rate of about 80 ft. per min. They are taken off alongside of the presses on which they are to be used.

As each plate moves off the elevator platform onto the conveyor it strikes a lever which starts the elevator motor and sends the elevator up to the third floor again. When the operator has placed another plate from the shaving machine on the elevator he presses a button and sends it down to the first floor. Fig. 5 shows the elevator discharging a plate to the conveyor. The elevator automatic control box is at the left in the photograph.

When the press work has been completed, the plates are removed and put back on the conveyor, which operates in a reverse direction and delivers them to the elevator. During this time the elevator reverse control box is swung aside. As each plate reaches the elevator platform an operator presses the button and sends it to the third floor where it is dumped off and put into the melting pot on the molder for re-use as metal.

FIG. 3 PORTION OF COMPOSING ROOM. PNEUMATIC TUBE DELIVERING COPY SHOWN AT UPPER RIGHT HAND

Paper for the presses is delivered in large rolls by truck from the railroad yards. The truck is of special low-body type and is shown in Fig. 6. It is driven into the building and onto an elevator of 37,500 lb. capacity, which lowers it to the basement. Here it is

unloaded either directly beneath the presses or in the paper storage. It is next driven to a turntable 24 ft. in diameter on which it is turned around. Then it returns to the elevator and is lifted to the street level

FIG. 4 SECTION OF MAKE-UP ROOM

to go after another load. Three times as much paper is brought in per day by this new arrangement as was handled at the old building. The storeroom holds 2500 tons of paper, a stock sufficient for two months.

Beneath the presses extends a frame-work to hold rolls of paper for feeding in. (See Fig. 7.) For each unit of the presses there is a triple holder consisting of a central shaft on which are mounted arms and reels (each equipped with a motor) for 3 rolls of paper. One of these rolls at a time is running into the press. The end of the second roll is smeared with paste, and, when the first roll arrives at the point of being completely used up, the paper-holder unit revolves and brings the second roll up, throwing the pasted end over and attaching it to the final end of the first roll. The empty spindle is refilled with a fresh roll of paper after it has swung down to the lowest position. This

FIG. 5 ELEVATOR AND CONVEYOR FOR STEREOTYPE PLATES

method of feeding eliminates the stopping of the presses and has increased their production capacity by from 18 to 25 per cent.

The press room on the street floor level extends the full length of the building along the 265-ft. side. The black press, built by R. Hoe and Company, is more than 150 ft. in length and is composed of 14 units, equal to 3½ octuples. These 14 units will put into the mail room in an hour 140,000 complete copies of the paper, 32 pages each, folded, counted and ready for delivery.

The 14 units can be used in any sort of combination according to the number of sections of the paper and the number of pages in each that are to be printed at one time. Eventually the press installation will consist of 18 units. The latest newspaper practice has abandoned individual presses and adopted the unit system, because it is flexible and saves the hand labor of putting sections together.

The color press rises through 2 stories. It stands end to end with the black press, making a line more

FIG. 6 SPECIAL TRUCK FOR BRINGING IN PAPER

than 207 ft. in length, and finally to be 260 ft. long when the 4 additional black press units are added. The color press is a 15-cylinder machine and can print simultaneously an 8-page comic section in 4 colors and a 16-page magazine section with front and back pages in 4 colors inside and out. Its capacity is 576,000 pages per hour.

Four folders serve the 14 units of the black press and one the color press, delivering newspapers to conveyors which carry them to the mail room on the second floor.

The mail room has a handling capacity of 48,000 papers per hr. The combined work table and conveyor system is 307 ft. in length. It runs the full length of one side of the room, thence across the end, back up the other side, half way across the other end, and finally down the middle of the room. In the center and also underneath each of the tables running up the two sides of the room are canvass traveling belts. The middle table is itself a traveling belt. (See Fig. 8.)

Two streams of newspapers, and sometimes four, are brought up from the press room by the conveyors and delivered at the southwest corner of the mail room

(to the right in the photograph) where the mailers' tables begin. These folded newspapers arrive in loose bundles of 50, overlapping each other.

A man stands by each conveyor and takes off the bundles of papers, combining 2 bundles into a package

FIG. 7 PAPER FEED REELS ELIMINATE STOPPING OF PRESSES

of 100 papers and placing them on the moving belt of the mailers' table. Some of the papers are for city delivery and these are tied up and dropped on an automatic elevator which takes them down to the newsboys' room below. Other papers are to go out on trains and boats to outside agents. These are bundled into addressed wrappers, tied with cord, and placed on the belt underneath the mailing table. The belt carries them to the front of the room, where they fall through a chute onto a truck outside of the building.

Still other bundles are wrapped for the smaller local carriers. These go down a second automatic elevator into the carriers' room, adjoining the newsboys' room, and are loaded through a chute directly into waiting trucks. By means of a special telephone and a loud speaker at the mailing room foreman's desk, the carriers and the delivery truck men waiting below are informed who are to get the bundles coming down the chute.

For individual mail circulation, papers are wrapped in single wrappers and dropped into mail bags hanging at the side of the table. As these bags are filled, they are placed on the belt beneath the table and go down a chute to a truck which delivers them to the post-office.

The mailing of Sunday papers is somewhat more complicated, and the entire room is taken up by the process. The magazine and comic sections, folded together, have come from the color press by conveyor to one side of the room, and are stacked in huge piles. On Saturday night the final news sections of Sunday's papers come up by conveyor, and must be inserted in the magazine section by hand. This work is done on the second and third stretches of the conveyor table.

Bundles of 100 are put on the conveyor belts of the mailers' table, pass down around the end of the room, and start up on the further side. Here the work of insertion is done when the papers have been lifted off the moving belt and set on the stationary border of the table, as shown in the illustration. They are assembled and made up in bundles of 100. Then the belt delivers them to the central portion of the room where they are prepared for delivery in the same manner as week-day issues. They are finally sent along on the belt beneath the middle conveyor line, and down a special chute used only for the Sunday issue.

FIG. 8 CONVEYORS ARE A NECESSITY IN MASS MAILING

Picking the Profitable Products

Method Used in a Small Plant to Determine Manufacturing and Profit Margin

By RUDOLPH ROSENTHAL

Assistant Treasurer, Jacques Kahn, Inc.

IN the work of improving the operation of a small-sized factory, it became necessary to investigate the cost and price relation of the product to find out what lines were profitable. The finished product was mainly mirrors, the raw material glass, and the manufacturing process comparatively simple. Manufacturing cost figures, based on present production methods, were available, and were estimated for improved conditions of minimum and maximum output in quantities.

In investigating the cost and price relation I had to find the margin between the present raw material cost and the prevailing price for the finished product. The difference between this margin and the manufacturing cost gave the profit figures.

There was no difficulty in determining the raw material costs, as only a few qualities and groups of sizes (brackets) had to be considered.

The price-list of the finished product, however, is much larger, over 1000 sizes being listed and each quality selling at a different discount. But a previous stock analysis[1] had given a table of the most used sizes in each quality, which simplified considerably the work of obtaining average unit prices.

Manufacturing cost figures per unit were available.

Prices for raw material and finished goods will show generally the same tendency as to rise and fall, but not at all points. These prices are influenced by different factors, such as original cost, general sales policies, competition, and larger or smaller use of some qualities or sizes by other industries.[2]

The most favorable margins in different qualities and sizes do not coincide with the most favorable manufacturing cost figures. Therefore, I had to find the field in which the highest average profit could be ascertained, considering also in which groups most of the business is attainable.

TABLE 1. ANALYSIS OF RAW MATERIAL PRICE-LIST

Cost differences per unit in different brackets and qualities.

Percentages on this table represent unit cost increase of a larger bracket above the lower one in each quality in same horizontal row.

Qualities	Brackets											
	R	%*	S	%	T	%	U	%	V	%	W	%
A	$0.32	.....	$0.32	.....	$0.45	40	$0.45	.....	$0.60	33	$0.65	8
B	0.36	.....	0.44	22	0.60	36	0.65	8	0.70	8	0.72	3
C	0.41	.....	0.50	22	0.70	40	0.80	14	0.90	12	0.95	6
D	0.45	.....	0.55	22	0.77	40	0.88	14	1.04	12	1.10	5
E	0.50	.....	0.60	20	0.84	40	0.97	15	1.08	11	1.14	6

* Read % horizontally.

TABLE 2. ANALYSIS OF RAW MATERIAL PRICE-LIST

Cost differences per unit in different qualities and brackets.

This table shows the percental cost increase per unit in each quality and bracket above the unit in the lower quality.

Qualities	Brackets											
	R	%*	S	%	T	%	U	%	V	%	W	%
A	$0.32	.....	$0.32	.....	$0.45	.....	$0.45	.....	$0.60	.....	$0.65	.....
B	0.36	13	0.44	40	0.60	33	0.65	44	0.70	17	0.72	11
C	0.41	14	0.50	14	0.70	17	0.80	23	0.90	29	0.95	32
D	0.45	10	0.55	10	0.77	10	0.88	10	0.99	10	1.04	10
E	0.50	11	0.60	10	0.84	9	0.97	10	1.08	9	1.14	10

* Read % vertically.

[1] See MANAGEMENT AND ADMINISTRATION, March 1925, "Handling a Complex Material Inventory," p. 267.

[2] In Section 10 of "Management's Handbook" under "Relation of Price of Raw Material to Product Prices," P. M. Marshall mentions some of the factors influencing prices, saying that these might have been wage rates in the several industries, or an increased demand for finished product, that was not accompanied by similar increased demand for other products made from the same raw material.

TABLE 3. ANALYSIS OF FINISHED GOODS PRICE-LIST

Cost differences per unit in different brackets and qualities.

Percentages show price increase of the larger bracket above the lower one in each quality.

Qualities	Brackets											
	R	%*	S	%	T	%	U	%	V	%	W	%
A	$0.73	.....	$0.87	20	$0.90	3	$0.95	5	$1.02	7	$1.03	1
B	0.73	.....	0.87	20	0.90	3	0.95	5	1.02	7	1.03	1
C	1.03	.....	1.08	5	1.13	5	1.19	5	1.27	7	1.29	1
D	1.37	.....	1.44	5	1.50	5	1.59	6	1.70	7	1.72	1
E	1.65	.....	1.72	5	1.80	5	1.91	6	2.04	7	2.06	1

* Read % horizontally.

TABLE 4. ANALYSIS OF FINISHED GOODS PRICE-LIST

Cost differences per unit in different qualities and brackets.
This table represents price increases of units in each bracket above the one in the lower quality.

Qualities	Brackets											
	R	%*	S	%	T	%	U	%	V	%	W	%
A	$0.73		$0.87		$0.90		$0.95		$1.02		$1.03	
B	0.73		0.87		0.90		0.95		1.02		1.03	
C	1.03	41	1.08	24	1.13	25	1.19	25	1.27	25	1.29	25
D	1.37	33	1.44	33	1.50	33	1.59	33	1.70	33	1.72	33
E	1.65	20	1.72	20	1.80	20	1.91	20	2.04	20	2.06	20

* Read % vertically.

The accompanying tables show the method used to achieve this result, without reproducing the charts used for graphic representation of each single group.

Tables 1 and 2 give the analysis of the raw material price-list and show the irregularities in the price increases from lower to higher quality and from the smaller to the larger sizes of product.

In these as in the following tables *A* to *E* represent qualities, *R* to *W* brackets. Brackets are sizes in a given square area—for example, all sizes between 5 and 7 sq. ft.

In Tables 3 and 4 the same representation is used for the finished product. The unit prices here represent the averages of the most used sizes of each particular group.

The manufacturing and profit margin per unit is shown in Table 5, and the final result of the investigation in Table 6, representing the profit after deducting manufacturing cost from the margin and showing the field of obtainable and profitable business. In this case orders of mixed quality or sizes make it necessary also to fill loss orders

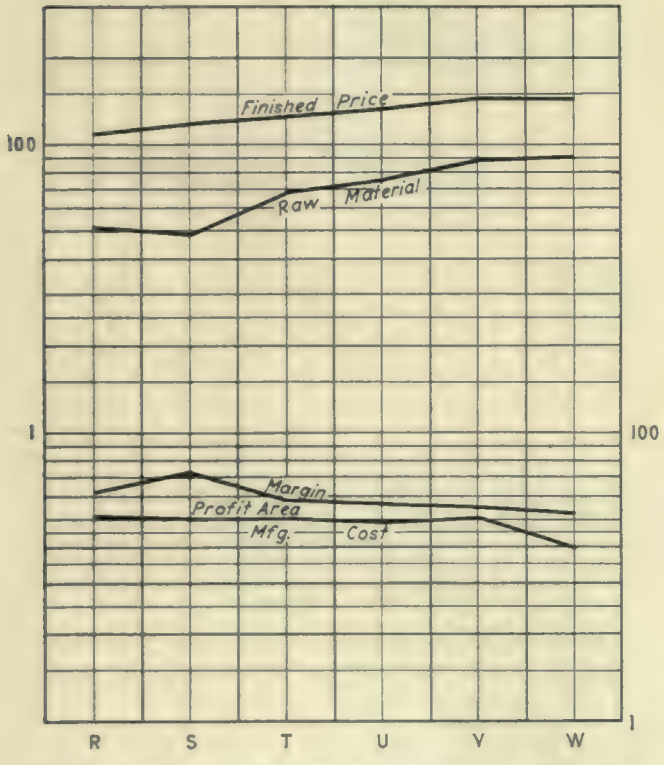

FIG. 1 AVERAGE UNIT MATERIAL COST, PRICE, MARGIN AND PROFIT PER BRACKET

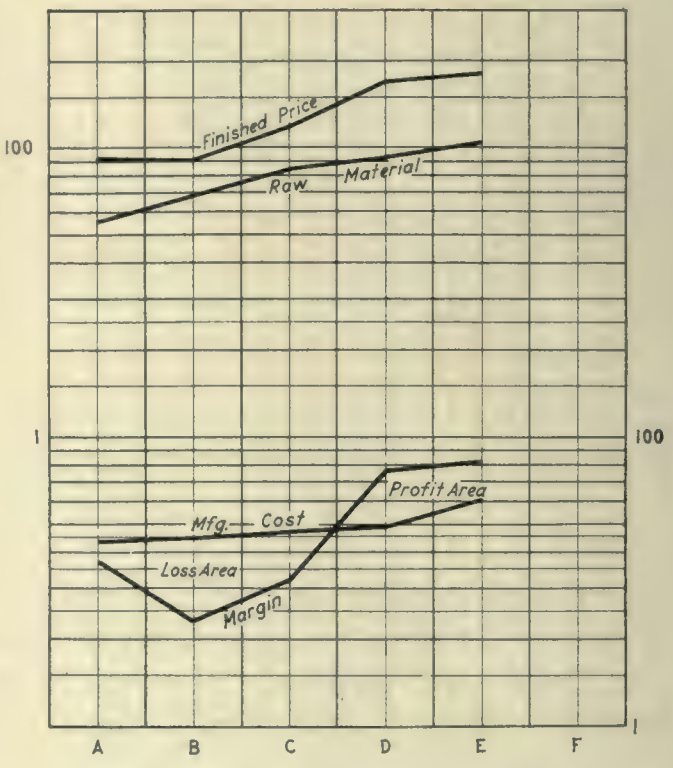

FIG. 2 AVERAGE UNIT MATERIAL COST, PRICE, MARGIN, AND PROFIT PER BRACKET

TABLE 5. MANUFACTURING MARGINS PER UNIT

This list shows the manufacturing margin per unit in each quality and bracket.

Qual.	Brackets																	
	R			S			T			U			V			W		
	*Mt.	Pr.	Mr.	Mt.	Pr.	Mr.	Mt.	Pr.	Mr.	Mt.	Pr.	Mr.	Mt.	Pr.	Mr.	Mt.	Pr.	Mr.
A	$0.32	$0.73	$0.41	$0.32	$0.87	$0.55	$0.45	$0.90	$0.45	$0.45	$0.95	$0.50	$0.60	$1.02	$0.42	$0.65	$1.03	$0.38
B	0.36	0.73	0.37	0.44	0.87	0.43	0.60	0.90	0.30	0.65	0.95	0.30	0.70	1.02	0.32	0.72	1.03	0.31
C	0.41	1.03	0.62	0.50	1.08	0.58	0.70	1.13	0.43	0.80	1.19	0.39	0.90	1.27	0.37	0.95	1.29	0.34
D	0.45	1.37	0.92	0.55	1.44	0.89	0.77	1.50	0.73	0.88	1.59	0.61	1.04	1.70	0.66	1.04	1.72	0.66
E	0.50	1.65	1.15	0.60	1.72	1.12	0.84	1.80	0.96	0.97	1.91	0.94	1.08	2.04	0.96	1.14	2.06	0.92

* Mt. = Material; Pr. = Price; Mr. = Margin.

TABLE 6. MARGIN MANUFACTURING COST AND PROFIT PER UNIT

This list shows the profit per unit in each quality and bracket, considering raw material cost, finished goods price and manufacturing cost. The bracketed figures represent the main obtainable business, of which the dotted line indicates the profitable part.

Qual.	Brackets																	
	R			S			T			U			V			W		
	*Mr.	Co.	Pf.	Mr.	Co.	Pf.	Mr.	Co.	Pf.	Mr.	Co.	Pf.	Mr.	Co.	Pf.	Mr.	Co.	Pf.
A.....	$0.41	$0.48	−$0.07	$0.55	$0.46	+$0.09	$0.45	$0.46	−$0.01	$0.50	$0.44	+$0.06	$0.42	$0.44	+$0.02	$0.38	$0.34	+$0.04
B.....	0.37	0.50	− 0.13	0.43	0.48	− 0.05	0.30	0.48	− 0.18	0.30	0.44	− 0.14	0.32	0.46	− 0.14	0.31	0.34	− 0.03
C.....	0.62	0.52	+ 0.10	0.58	0.50	+ 0.08	0.43	0.50	− 0.07	0.39	0.46	− 0.07	0.37	0.48	− 0.11	0.34	0.36	− 0.02
D.....	0.92	0.52	+ 0.40	0.89	0.50	+ 0.39	0.73	0.50	+ 0.23	0.71	0.46	+ 0.25	0.66	0.48	+ 0.18	0.66	0.40	+ 0.26
E.....	1.15	0.63	+ 0.52	1.12	0.60	+ 0.52	0.96	0.60	+ 0.36	0.94	0.59	+ 0.35	0.96	0.65	+ 0.31	0.92	0.54	+ 0.38

*Mr. = Margin; Co. = Cost; Pf. = Profit.

at a time when general market conditions were unfavorable.

There remained the necessity to represent graphically the tendency of raw material and finished product prices, as well as the margin, manufacturing cost and profit or loss for each group.

This was done for each group separately, but is shown here as a total only, using the average figures for all brackets and qualities as in Table 6 and graphically represented on ratio charts, Figs. 1 and 2.

Undoubtedly in many of the smaller industries, where standardization of product has not even been attempted, many variations exist in manufacturing margins. Raw material price-lists are not consistent, and the price-lists for the finished product show many irregularities. They are often based on older lists. In many cases factors enter which make the reason for the divergencies hardly discoverable. The consequence is that the production manager not familiar with these facts might vainly try to make the manufacturing cost of some units fit the margin, or the sales manager might apply his efforts in the wrong direction.

In such cases where price-lists cannot be changed by individual manufacturers, an analysis along lines similar to the method shown is necessary to give a clear picture of conditions to all concerned.

TABLE 7. COMPARISON OF AVERAGE RAW MATERIAL COST AND FINISHED PRICE, MARGINS AND MANUFACTURING COST PER BRACKET, AND PER QUALITY

This table averaging all qualities and brackets shows average profit or loss of each group. The ratio charts, Figs. 1 and 2, represent in graphic form the figures of Table 7.

All Qualities	Brackets					
	R	S	T	U	V	W
Raw material cost	$0.51	$0.48	$0.67	$0.75	$0.86	$0.91
Finished price	1.10	1.20	1.25	1.32	1.41	1.43
Margin	$0.61	$0.72	$0.58	$0.57	$0.55	$0.52
Manufacturing cost	0.53	0.51	0.51	0.48	0.50	0.40
Profit	$0.08	$0.21	$0.07	$0.09	$0.05	$0.12

All Brackets	Quality				
	A	B	C	D	E
Raw material cost	$0.56	$0.69	$0.85	$0.94	$1.05
Finished price	0.92	0.92	1.17	1.72	1.86
Margin	$0.36	$0.23	$0.32	$0.78	$0.81
Manufacturing cost	0.44	0.45	0.47	0.48	0.60
Profit or loss	−$0.08	−$0.22	−$0.15	$0.30	$0.21

Engineering Education—for Whom?

By E. H. FISH

SOME of our psychological-neuropsychiatric friends have recently been propounding the question whether it is worth while to offer education to anyone. They take the ground that each person is born with a certain potential intelligence, and that there is no way in which intelligence can be increased. Since these people make their own definition of intelligence to fit the argument, we will probably have to grant their argument and then discover some other name by which we can call the quality which makes some men more successful in overcoming obstacles than others.

These arguments set me to thinking of the engineering graduates I have known, and I made a sort of mental census of those whose career I have followed to see how far education may have proved a blessing. Of course, such an inventory is a matter of judgment, possibly of guesswork. But even guesswork spread over a large number of cases has something of a simulation of science.

In this instance, as a fellow student and, later, as a teacher, I have known over 1000 men who are now graduates of 15 years or more. Of these some have died, some have been so far away that I have lost track of them, some have been reticent about their connections, so that there is some doubt as to exactly what they have been doing.

But there remain 605 men who have been within reach, who have been successful in the ordinary meaning of the word, and perhaps more than that, because all of them have accomplished something more than making money. I have tried to classify these men in three groups: First, those who would probably have been much better off had they gone directly to some other kind of a school—business administration, for

the most part; second, those who markedly profited by technical training, and who could hardly have gained and held the positions which they have without it; third, those who could have attained their present objective through some means more common than an engineering education.

The score was as follows:

First, handicapped by their lack of training..... 40
Second, profiting from their training.....350
Third, not especially profiting from their training.....210

If this proportion holds good, it means that somewhat more than a third of those who graduate from engineering schools find themselves years later making good in professions which they could have entered by a shorter and easier course. But it does not appear that these men have had any less need of intelligence or education because they have not trodden the exact path which their degree contemplated.

Men Following Their Chosen Profession

How about the men who have profited by their education well enough to stick to their line for 15 years and more? The peculiar thing is that the proportion is greatest among electrical engineers. They seem to find their work interesting and profitable, or else they find it harder to get out of, because there they are. The chemists come next, the civils third, and the mechanical engineers—well, it seems as though there was no such thing as a mechanical engineer left. They go to selling something that requires little or no mechanical ability, to business administration, to law, teaching, or editing—but principally to selling.

In fact, it is hard to define a mechanical engineer in the light of the great number of things they enter that call for a considerable technical knowledge of mechanical affairs. Electrical engineering seems to be partly mechanical engineering plus a certain amount of purely technical development in a highly specialized subject. Heating and ventilating engineering, hydraulic engineering, and all such, are advanced branches of mechanical engineering.

Perhaps an engineering course should consist of two or three years of straight mechanical studies, plus one or two years of specialization in some branch which will enable the graduate to step at once into a position where he can be worth his keep. This is probably one of the reasons why electrical graduates stick to their last better than the others. They have a market value immediately on graduation. A man who goes into the mechanical department of a rolling mill, a rubber factory, or a pump factory, has a great deal to learn, and very little to give, during his first year. If he goes to one of the great electrical concerns, however, he finds a niche already carved out to fit him. He is worth something from the start, and in a short time he is earning enough to induce him to continue in the profession. Things that attract mechanical engineers away from their profession do not appeal to him because he is too busy to see them as opportunities.

How about the small class, 1 in 15, whom I have rated as handicapped by having had an engineering education? These comprise for the most part men with distinctly visible managerial capacity. A man who can make a student paper pay up past deficits and produce a dividend is wasting the time he spends in learning about the ellipse of stress. After graduation he can hire plenty of men with such technical knowledge for far less than he himself can make through exercising his business ability.

What conclusion can be drawn from this inventory? Possibly this: The majority of men who graduate from technical schools make good use of their education in fields where their technical knowledge finds a sales value.

All these men passed a very rigid intelligence test before they were ever admitted to study for a degree. Their high school studies and their entrance examinations constituted a test that not only parallels but is more severe than any of the set intelligence tests. Moreover, their reactions to these tests were observed over a period of years, while their ability was in the formative state. It is pretty safe to say that very few unintelligent men ever get into an engineering school. Then after they are in, the testing process goes on for 4 years more before they graduate. During this time half of them drop out.

So we have at the time of graduation a picked lot whose range of intelligence is much greater than that of the run of men. Yet it appears that these men in large part have profited by the addition of education. To be sure our psychologically inclined friends are likely to say that they have acquired information rather than added intelligence, but even they consider the extent of the student's information in judging his intelligence.

Where the Need for Education Lies

The last conclusion which I arrive at—one which may find many to dispute it—is that we are offering education to those who need it the least.

Some educators, the president of Dartmouth particularly, have objected to the inrushing tide of men who want a college education. They find themselves swamped. Their method of seeking relief is to raise the entrance requirements so as to cut out still more of the men whose intelligence is not already of the highest. Yet I am very sure that this will ultimately reduce those accepted by the colleges to the very group of men who could and would make their mark in the world with no education at all, in the accepted sense.

There are thousands of young men and women who could profit from education in some line but who are barred from getting it because the tests for admission are so exclusive. But they need education. They cannot make the showing that present-day graduates do, but is it not a great waste of public funds to eliminate from colleges and engineering schools a large group of persons who might easily become more competent producers, abler commercial men, or better executives, by training? The agricultural colleges have done wonders in this direction, and from their work we are all profiting. Cannot the engineering colleges profit by their example?

Avoiding Losses in Incorrect Power Cost Distribution

By WALTER N. POLAKOV

Consulting Engineer

CORRECTLY to allocate the cost of power to different kinds of product manufactured is an important and sometimes intricate matter. It is important because upon the correct determination of this portion of the total cost of production depends correct pricing of the goods. Therefore the selling policy adopted may either contribute to prosperity or drive the concern to the wall. It is

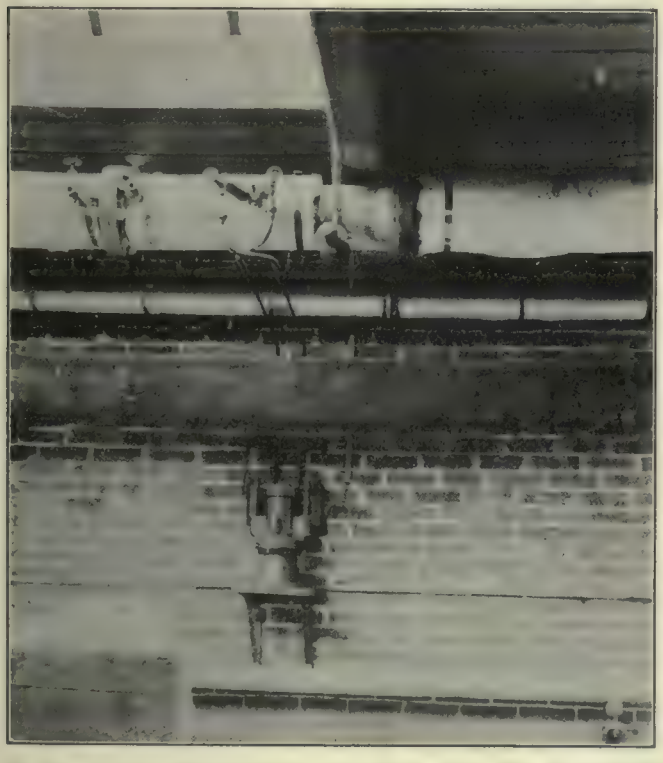

FIG. 1 STEAM PIPE PLUGGED FOR METERING. EITHER ORIFICE OR NOZZLE MAY BE INSERTED INTO STRAIGHT RUN OF PIPE TO MEASURE THE FLOW

intricate whenever various kinds of manufactured products are not processed in an identical manner or do not pass through the same departments. The matter is further complicated when various forms of power are used, such as live steam, electricity, hydraulic power, pneumatic power, refrigeration, etc., especially if some of these forms of energy are supplied from different sources, that is, when electric power is generated partly by water wheels, partly by steam and partially purchased from outside, or live steam is furnished from different boiler houses, using different fuels, etc.

It is not uncommon to find situations where the cost of product is increased or decreased 10 per cent by fluctuations in power cost increment. Yet one-third of a cent difference per yard in quotation for finishing cloth would probably mean rejection or acceptance of a bid. In industries where power cost is a large item, such as rubber, textile finishing, food products, storage and refrigeration, chemicals, sugar refining, pulp and paper, etc., the problem of cheap and correctly allocated power cost is of great importance. Again, in industries which use great quantities of fuel, such as oil refining, soap, cement, metallurgical plants, etc., even if power is only a small percentage of the total expense, correct determination of the cost of the various kinds is conducive to great economies by directing the attention of the executives toward preventable waste.

It has been customary to side-track such problems by requesting someone in the mechanical department, or even a clerk in the accounting office, to distribute power costs on the books. The task generally winds up in rough-and-ready estimates of motor capacities, floor areas, etc., and digging out some sort of "constants" published some time ago, somewhere, in relation to something. Such a method, even if based on correct determinations verified by tests, does not take into account the current changes in proportions of goods passing through different processes, variable quantities of different kinds of power consumed, atmospheric influences, etc. Such a practice is, therefore, decidedly worse than none, or bold neglect of the problem by treating the entire power expense as one item of "overhead" equally distributed on "righteous and damned."

Of late, however, all far-sighted managers and the leading accountants have come to realize the importance of the problem and the demand for competent counsel in the matter has grown almost over-night.

Equipment for Power Measurement

Steam, electricity and other forms of power consumed in the processing or manufacturing of goods represent money spent for fuel, labor, supplies, repairs and overhead expenses. In an average concern in any plant of the above mentioned industries power represents an annual outlay of from $50,000 to $500,000. To handle funds of such magnitude no office manager would hesitate to buy an adding machine, or a set of books to insure accuracy, or to invest in a safe to keep them secure, if in cash. Yet none of these office appliances helps in the least to prevent the loss

of business through unnecessarily high price quotations, or loss of profit through low quotations, or loss of money through undetected power leaks, or misuse, or obsolete methods of using power.

Reliable metering is now recognized as an essential

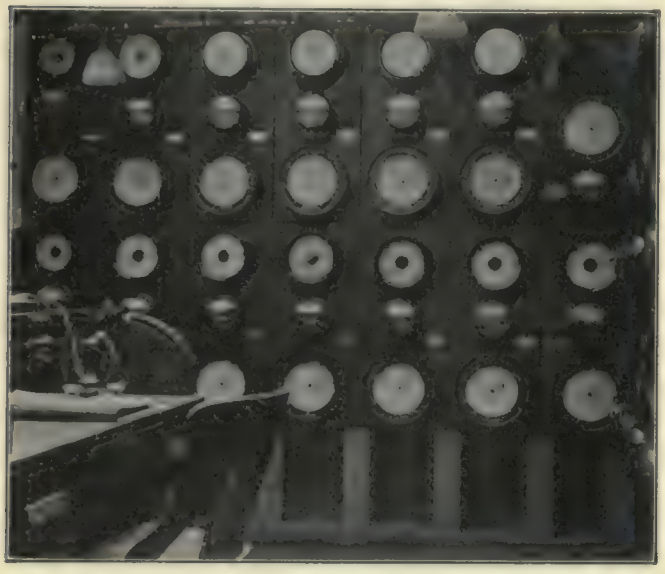

FIG. 2 PANEL BOARD WITH INTEGRATING AND RECORDING FLOW METERS INSTALLED IN THE DISPATCHER'S OFFICE

means of executive control over both prices and costs. The design and operation of electric, gas and water meters are sufficiently familiar to all and require no explanation here. Steam flow meters may be mentioned in passing to emphasize the obvious and proved advantages of the electric type flow meters, particularly for the reason that the locations of recording and integrating dials are independent of the place of actual metering of the flow. When this feature is desirable in connection with metering gas and water, similar flow meters could be installed on these lines as well, thus permitting observations and reading of all meters from one central panel board conveniently situated, irrespective of the situation of the meters themselves. (See Figs. 1 and 2.)

Preliminary Studies

The first step in apportioning power costs to product is logically in the direction from the product toward the power plant and not the reverse. It is usually convenient to begin with the analysis of current prices of different kinds and qualities of goods manufactured. Having these differences in mind, the sequence of operations or processes through which the goods pass must be clearly visualized and an estimate made of the kind and relative amount of power consumed in each. For instance, paper made of pulp and paper made of rags would go through different processes and consume different amounts of power; likewise some cotton goods are mercerized and some are not, and this one extra process involves refrigeration of caustic soda, steam for recuperators, electricity for pumps and for motor drive, etc.

When such essential information has been gathered and organized, a study of pipe lines and wiring should be made and plans, or at least diagrams, prepared. Then, and not before, it is wise to spot the prospective location of necessary and sufficient meters. Departments or processes, even within a department, if they are large consumers of, say, steam, should be metered directly as far as practicable, while the smaller consumers on branch lines or farther down the lines may be accounted for by differences. In certain cases,

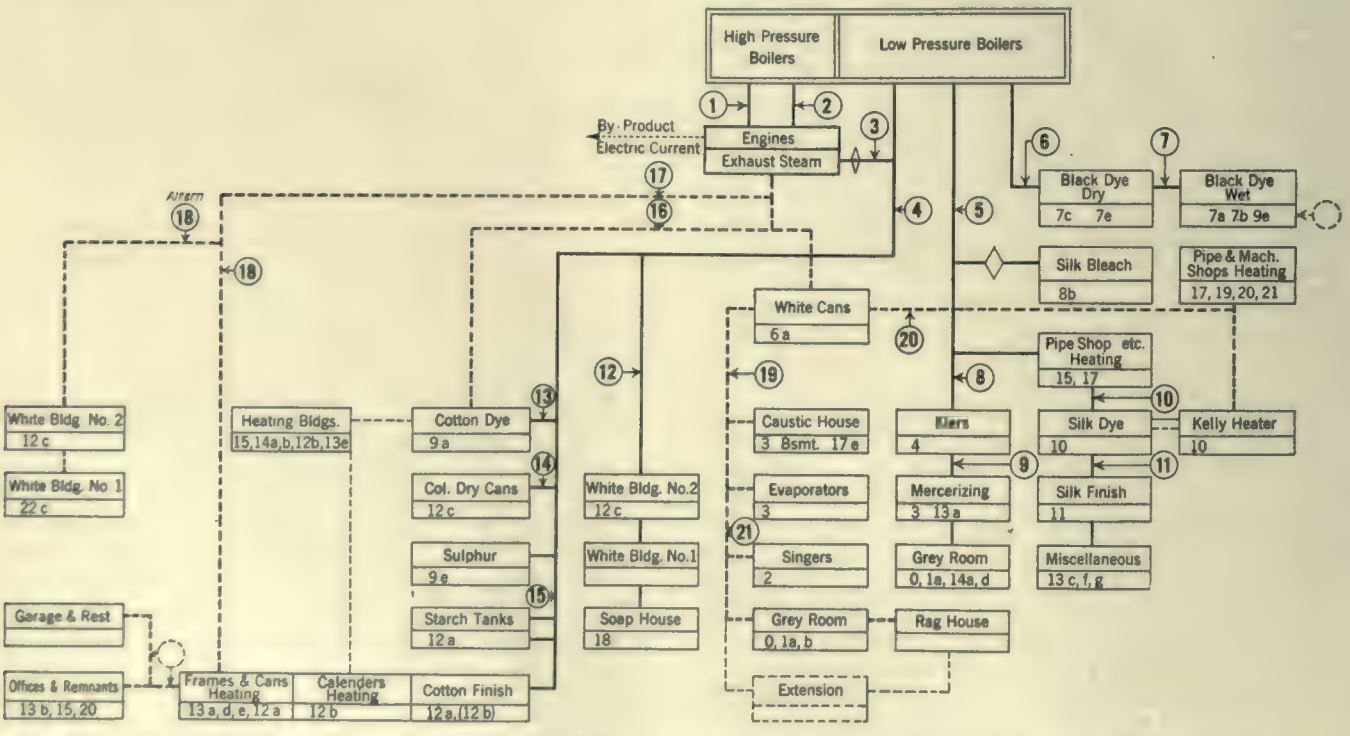

FIG. 3 SCHEMATIC PLAN OF LOCATION OF METERS ON STEAM LINES FOR CHARGING CONSUMPTION TO PROPER ACCOUNTS

definitely established constants may do, if processes are well standardized and other records are available and reliable, while in other instances results may be secured by slight changes in pipe or conduit lines. When a decision to meter steam and power is made, expert

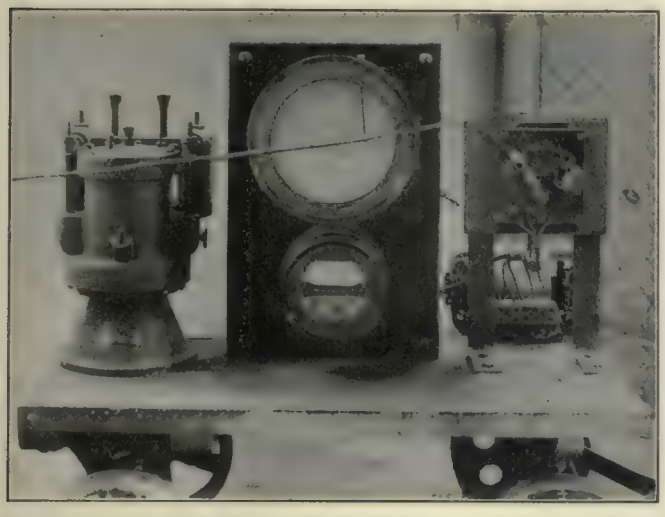

FIG. 4 TRUCK WITH STEAM-FLOW METER FOR TESTS AND FOR DETERMINATION OF AVERAGES

advice is capable not only of saving tenfold in cost of superfluous meters but sometimes will save the whole plan from being rendered worthless or inoperative.

Fig. 3 shows the correlation of meters (indicated by numbered circles) and the accounts to which the charges are to be made, in a textile finishing plant. The location of meters on the pipe lines permits differentation between high-pressure, low-pressure and

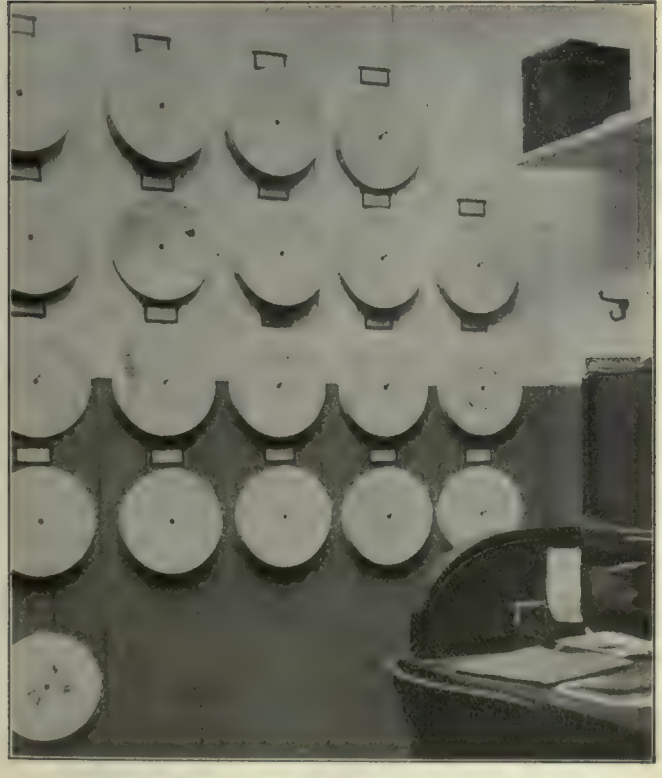

FIG. 5 POWER DISPATCHER'S DESK AND RECORD CHARTS KEPT ON PEGS UNTIL BILLED AND FILED AWAY WEEKLY

exhaust steam, and, except in certain cases of heating, all major steam uses are accounted for, covering over 88 per cent of the total steam and leaving but 12 per cent to be distributed by means of predetermined con-

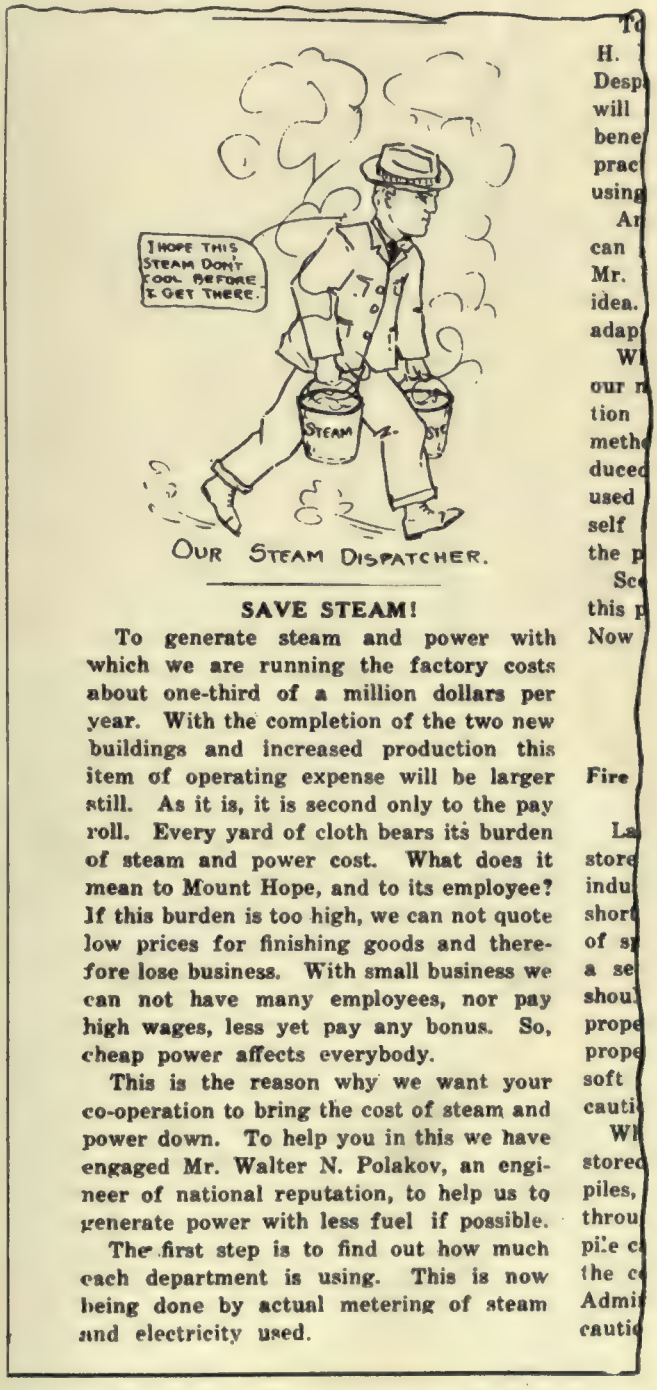
I HOPE THIS STEAM DON'T COOL BEFORE I GET THERE.
STEAM
OUR STEAM DISPATCHER.
SAVE STEAM!
To generate steam and power with which we are running the factory costs about one-third of a million dollars per year. With the completion of the two new buildings and increased production this item of operating expense will be larger still. As it is, it is second only to the pay roll. Every yard of cloth bears its burden of steam and power cost. What does it mean to Mount Hope, and to its employee? If this burden is too high, we can not quote low prices for finishing goods and therefore lose business. With small business we can not have many employees, nor pay high wages, less yet pay any bonus. So, cheap power affects everybody.
This is the reason why we want your co-operation to bring the cost of steam and power down. To help you in this we have engaged Mr. Walter N. Polakov, an engineer of national reputation, to help us to generate power with less fuel if possible.
The first step is to find out how much each department is using. This is now being done by actual metering of steam and electricity used.

FIG. 6 ANNOUNCEMENT OF PLAN TO MEASURE DISTRIBUTION OF STEAM USED IN MT. HOPE FINISHING COMPANY'S PLANT

stants, or a portable test-meter. A picture of such a portable steam-flow meter mounted on a truck is given in Fig. 4.

It is good practice to read the most important meters daily and enter the readings on the log. When a chart record is kept in connection with meters, these charts are preserved for a week on suitably arranged pegs, as shown in Fig. 5. The additional advantages

UNITED REFRIGERATION & TERMINALS CO., INC.

Meter Readings - Week Ending Jan. 10 1925

BORDEN'S F. P. CO.

WELL WATER	Present	
	Last	
	Cu Ft. Used	
CITY WATER	Present	
	Last	
	Cu Ft Used	
HOT WATER	Present	
	Last	
	Cu. Ft Used	
STEAM	Present	
	Last	
	Lbs Used	
ELECTRIC No 1	Present	17 820
	Last	15 270
	K W H Used	
ELECTRIC No 2	Present	71 990
	Last	70 160
	K W H. Used	1 830

CLOVER FARMS

WELL WATER	Present	950 882
	Last	929 358
	Cu Ft Used	21 524
CITY WATER	Present	
	Last	
	Cu Ft. Used	
HOT WATER	Present	072 552
	Last	060 938
	Cu Ft. Used	11 614
STEAM	Present	
	Last	
	Lbs. Used	145 863. 74
ELECTRIC	Present	15 930
	Last	14 980
	K W H Used	950

MOTHER'S FRIEND

HOT WATER	Present	6 102 929
	Last	6 091 949
	Cu Ft. Used	10 979
CITY WATER	Present	6 904 321
	Last	6 887 390
	Cu Ft. Used	16 931
STEAM	Present	
	Last	
	Lbs. Used	30 982
ELECTRIC	Present	22 770
	Last	21 830
	K W H Used	940

AMERICAN WET WASH

HOT WATER	Present	
	Last	
	Cu. Ft. Used	
CITY WATER	Present	
	Last	
	Cu. Ft. Used	
STEAM	Present	
	Last	
	Lbs. Used	
ELECTRIC	Present	
	Last	
	K. W. H. Used	

ENGINEER'S GARAGE

STEAM	Present	
	Last	
	Lbs. Used	14 526
ELECTRIC	Present	08 610
	Last	08 510
	K. W. H. Used	100

DEWET GARAGE

STEAM	Present	
	Last	
	Lbs. Used	120746. 7
ELECTRIC	Present	
	Last	
	K. W. H. Used	

INTERBOROUGH FUR STORAGE

ELECTRIC	Present	
	Last	
	K. W. H. Used	
STEAM	Present	
	Last	
	Lbs. Used	

UNITED R. & T. CO.

CITY WATER		
Meter No 18169	Present	4 988 817
	Last	4 968 110
	Cu. Ft. Used	20 707
Meter No. 508551	Present	6 118 206
	Last	6 031 896
	Cu. Ft. Used	86 310
Meter No 186465	Present	5 357 560
	Last	5 280 230
	Cu. Ft. Used	77 330
Meter No 459024	Present	364 964
	Last	364 398
	Cu. Ft. Used	566
Meter No. 476948	Present	76 228 580
	Last	76 091 830
	Cu. Ft. Used	136 750
Meter No. 447560	Present	06 412 690
	Last	06 349 320
	Cu. Ft. Used	
Meter No	Present	
	Last	
	Cu. Ft. Used	

STEAM

MAIN LINE		
	Lbs. Production	4,439,325

ELECTRIC

Old Garage	K.W.H.	4370
New Garage	K.W.H.	3820

DYNAMO ROOM

TOTAL METER		
	K. W. H. Produced	25 296

WELL WATER

MAIN METER	Cu. Ft.	
METER	Cu. Ft.	

FIG. 7 FORM FOR WEEKLY METER READING TALLIES

derived from such information will be discussed later.

At least once a week a summary of all meter readings should be made, either on a form similar to Fig. 7 designed for a refrigeration and terminals corporation preliminary to the disbursement of charges to their tenants and customers, or entered daily, together with price, as inaugurated at the Mount Hope Finishing plant. These steam dockets are prepared for each department. The original is sent to the accounting department, which bills each department for service received, while the copy is given to the foreman of the department for his information and guidance.

Pricing of Power

At this stage of the work a knowledge of the cost of various kinds of power is necessary. A large loft and storage company had been charging its tenants $0.20 per 1000 cu. ft. of hot water, whereas the cost of live steam used for the purpose and value of the condensate was actually in excess of $3. In another case a concern had its refrigeration service underpriced, thus failing to charge to the proper account and the corresponding product some $11,000 monthly. In still another case a company figured the cost of electric current by including in it all steam and labor, in spite of the fact that if steam were not passed through the engines it would have to pass through a reducing valve to be made available for the processing, and the labor, of course, performed a number of other duties. As the result of such overpricing of electric current it was thought advisable to buy electricity from outside, with the consequence that, in the one year during which power was purchased, about $17,000 was paid in excess of what it actually would have cost to produce the same amount of power.

Then, again, there are conditions under which it is advisable not to price certain forms of power on the basis of strict manufacturing expense, nor proportionate to the heat value, but to treat them like exhaust steam, as a by-product, and sell them to manufacturing departments at reduced prices. Sometimes we may consider electricity as a by-product. This policy is often advisable wherever a department foreman is inclined to favor the use of live steam, although exhaust would do equally well and, unless so utilized, would go to waste through a pipe to the roof. In such instances, foremen, accountable for the operating expenses of their departments (or participating in economies) are vitally interested in using by-product steam at a reduced price. At the same time the concern accounts for every cent spent, without overburdening the cost of the major forms of power.

(To be concluded in the June issue.)

Production Executives' Conference

A CONFERENCE of the Production Executives' Division, American Management Association, devoted entirely to "Financial Incentives," will be held at the Drake Hotel in Chicago on May 21-23, 1925. The discussions will include: Methods of Introduction and Operation of Extra-Incentive Wage Plans; Problems Met and Dangers to Avoid; Results Secured; Extra-Incentive Plans for Foremen, Executives, and Non-Productive Workers; Details of New Plans; and What Is Surviving in Wage Payment Plans.

Executives from representative organizations will tell of their experiences with the extra-incentive plans now in operation in their respective concerns. At the dinner meeting on May 22, well-known speakers will talk on various phases of such extra-incentive plans.

"Undesirables Keep Out!"

Watchmen and Badges Protect Plant and Property

By L. M. STOWELL

Employment Manager, Detroit and Cleveland Navigation Company

THREE gentlemen crossed the street to the side gate of one of several plants belonging to a large Detroit firm and, pushing open the door, were continuing into the building when they were halted by the watchman. "May I see your pass, please?" he inquired pleasantly of the group.

"I am one of the officials of this company. My name is James Blank. These gentlemen are my guests and we do not need a pass," the spokesman curtly replied and started again into the plant.

"I don't know if you are Mr. Blank and I don't care a cuss if you are, for if you are Mr. Blank you certainly are not backing up your own watchman in carrying out your own printed instructions," the guard answered emphatically and pulled out of his pocket a small card of badge rules under the firm name and offered it to the speaker. Then he added, "So please go in the superintendent's office next door and get a pass."

Mr. Blank looked at him a moment, rather dazedly, then turned on his heel and went to his superintendent for a pass into his own plant for himself and guests. Incidentally, he told of being held up at the door and then asked a few searching questions of the superintendent about the watchman. These being answered favorably, he advised that the man be given a raise and that he be transferred to the main gate as soon as convenient.

A prominent official of another large local firm was also delayed by one of his plant watchmen while hurrying one morning to his office. He was so annoyed that he brushed the guard aside and told him to report to the time office for his money. Upon reaching his office, however, the official reconsidered the situation and had the watchman placed as a guard in a leading downtown bank, which was not at all a bad transfer.

Now such cases are not altogether uncommon, also neither was perhaps handled in "the one best way" by the parties involved. On the part of the officials, both were in a sense wrong, yet they promptly made amends. The watchmen were less tactful than courageous, yet they were at least up to the standard of plant watchmen.

Proper guarding of entrances and exits of large industrial plants is simple in theory but the successful operation consists of important details.

The location and number of plant gates should be carefully planned according to most advantageous arrangement for incoming and outgoing traffic. This is ordinary routine in the laying out of plans for modern plants, but even in older building groups, both the vehicular and foot traffic may be so routed as to insure a minimum of confusion.

All traffic must be properly identified before entrance into the plant or exit from it. Vehicles must pass inspection and, if from outside firms, be registered as they enter and leave the plant. All employees, guests and those with special business should be distinguished by badge or pass.

Employment of Watchmen

Each plant should have a chief or superintendent over all watchmen. The chief and one or more of his force should be legally empowered to arrest or discipline offenders against property or person. The watchmen's department should at all times be connected by phone or electric buzzer with certain departments likely to need sudden assistance, such as the office of the shop superintendent, and the time and employment offices.

The demands of a modern industry seem to call for a departure from a former custom of recruiting the watchmen from the aged, infirm and crippled among employees of long standing. In many cases this can still be done with justice to all concerned and at such times is a commendable act. Increasingly often, however, to segregate a formerly active, skilled mechanic in a sedentary job with longer hours and outside exposure, with little physical activity, and with added demands for specialized mental ability of a vastly different kind than his trade called for, makes of him a physical failure in this new work.

Safes for money and securities are not made of wood or other quickly perishable material, nor is valuable manufacturing equipment housed in flimsy buildings. Likewise then, the property as a whole should not be "guarded" by men mentally or physically unfit. Worthiness of an employee is a big asset to a firm and should be encouraged but it can be developed and compensated in better and less costly ways.

It is well, too, that watchmen be occasionally changed about from one gate to another to prevent the watchman working with unscrupulous employees to their mutual profit.

Discipline is more easily maintained and more respect is given to the guards if they are in uniform or wear a distinguishing type of badge on their regular clothing. A good, live watchman enjoys his post if his position is readily recognized by his fellows as well as by outsiders.

Identification of Employees

For employees a metal badge is used for identification, with a card pass provided for officials and certain executives. Sometimes a special badge is used bear-

ing the title of position, as in the case of foremen and assistants, time study men, etc. All these may be had in stock design or they may be made up in any design wished for by firms specializing in badge work. A local manufacturing jeweler, or a builder of rubber and metal stamps, often can fill small orders.

The pass prepared for executives and officials carries space for name of bearer, date issued, and the limits, if any, as to its use, and is issued from the office of the president or an appointed official. The pass is returnable at the expiration of service.

The badge routine for the regular shop employees, to be described, is a composite of methods successfully planned and followed in plants with pay-rolls numbering from 8000 to 16,000 employees, where the writer has been engaged for the development of the badge service.

The Use of Badges

In an organization consisting of several separate and scattered buildings, with 15,000 employees, there are needed some 35,000 badges. In a smaller plant, with everything under one roof, there would be less difference between the number of badges and employees. If blanks are purchased with the original order, losses and damages may be replaced by using the same badge and clock number. Otherwise new numbers have to be added to the pay-roll as well as to the badge totals.

In a scattered plant, the separate buildings must be grouped to form a workable unit and different base colors and combinations must be assigned to each unit. Each unit has a color and series of numbers distinguishing it from the other units, with the possible exception of the construction, maintenance, millwright and repair men, whose work makes them subject to call into all parts of the plant. Truck drivers and garage men should be allowed greater freedom than those confined to one building, so for these outside groups a badge is designed which shows their greater working range. With these restrictions, the gate watchmen can detect employees roaming about outside their departmental limits. Most of these distinguishing marks may not be needed in the industry under one roof, as the clock number and letters of the department may be enough.

New employees are given paper tags bearing clock number, and date, good for three days, and are instructed in their use. The tags may be green the first three days of the week, while red may be used the latter half of the week. This enables the watchman readily to hold up those employees not changing tag for metal badge after the three-day limit. In case of sickness or other justified cause, the tag may be carried into the second week. If tag or badge is lost or left at home, an employee coming to work without it goes to the badge office for a pass for one day only. If this occurs more than twice a charge is made, which is refunded later upon return of the badge. This charge may range from $1 to $5 and is made fairly high so that these tickets of admission will not be lost too often or be loaned by their rightful owners.

When an employee leaves or is transferred the badge or tag is turned in with the time-card, or, if lost, a charge is made, the clearance form being so marked by the badge clerk for the guidance of time-keeper or cashier. In the badge office a card is made out, containing a record of the transaction which is filed until the badge is returned. If not returned in two or three months, a duplicate badge is prepared from the blanks on hand and the clock number is then released for use on the pay-roll, it having been closed while the badge was out of circulation. In case of shortage of clock numbers, of course this time limit may be lifted, but it is seldom necessary or expedient.

Maintenance of Badge System

The badge account may and should be kept practically 100 per cent correct. By simple attention to the handling of badges and by care in the use of the card record, the clerk is able at any time to account for all badges. If the employee in the shop hasn't it as issued, the cashier has the equivalent in cash, or in case of non-collection of forfeiture the case is known and listed.

All losses are automatically reported, as the employee losing a badge is given a tag of distinctive color—yellow contrasts well with the green and red used daily for newcomers—and is made good for ten days. At this time, if the badge is not returned, the employee signs an order for the duplicate badge, which is at once made. He receipts for it and either pays for it in cash or authorizes the deduction to be made from his pay. Upon return of the badge at any later date, refund is made if the employee is still in the company service or can be conveniently located, and the original, if in good condition, is substituted for the made-up duplicate, which is then drawn from circulation. It is kept on file, however, for future use.

A neat, attractive badge design, containing some recognized symbol of the company, is well worth the investment. It is usually typical of the firm it represents and, consciously or otherwise, it is usually so interpreted. A symbolical and attractive design will be continuously and proudly worn by its owner. This helps the gate watchman; it helps the foreman, the inspector and the clerk readily to recognize and group the men with whom they work, as well as to charge jobs more easily to those who produced them. On the street car and among outside pedestrians there are many instances where badges have proved good advertising for the firm. In a dull season particularly this display seems to cause belief that the "Blank Company must be doing good business, for look at all its people working." This is even noticeable in the employment office, as good men out of work through no cause of their own are often thus attracted to such a firm.

All of the reports and records, kept in a large or widely scattered organization, should be handled by the office in each of the separate plants. Monthly reports may be submitted to a central office, showing a complete inventory of badges and of moneys held for them. A further periodical check, made by a representative from the central office, usually from that of the paymaster or the auditor, is advisable.

Good Factory Air Pays In Increased Output

Air Conditioning for Greater Production

By A. G. ANDERSON

Research Engineer in Industrial Management, University of Illinois

IN the past the responsibility for conserving the health and promoting the well-being of its workers was not accepted by industry, labor being treated as a commodity, plentiful and cheap. The economic loss sustained by the disability and slowing up of the workers due to poor ventilation was not appreciated. Today every effort is being expended to promote the efficiency of the human element in production, and engineers, physicians and physiologists are in substantial agreement as to the atmospheric conditions which should be maintained in factories.

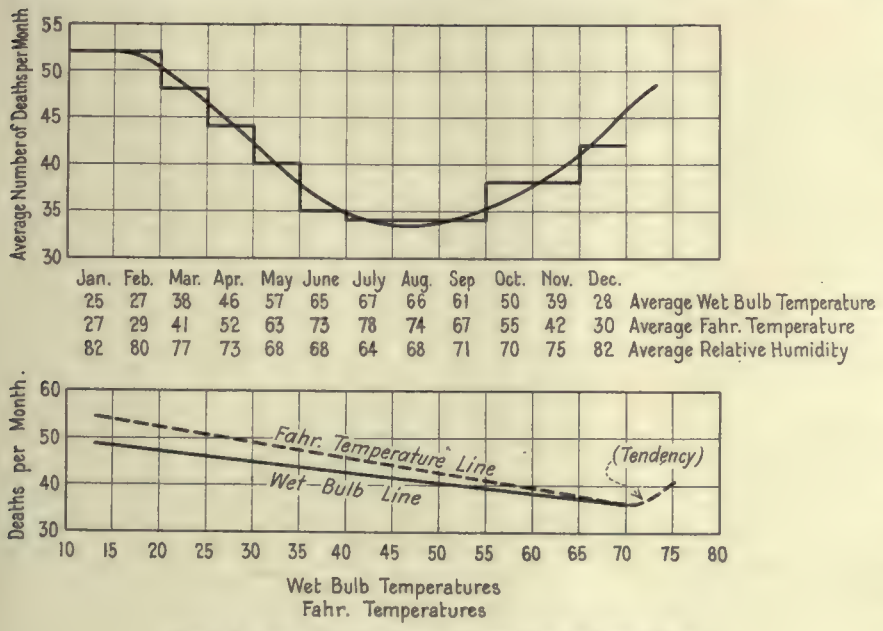
Average Number of Deaths per Month
55
50
45
40
35
30
Jan. Feb. Mar. Apr. May June July Aug. Sep Oct. Nov. Dec.
25 27 38 46 57 65 67 66 61 50 39 28 Average Wet Bulb Temperature
27 29 41 52 63 73 78 74 67 55 42 30 Average Fahr. Temperature
82 80 77 73 68 68 64 68 71 70 75 82 Average Relative Humidity
Deaths per Month.
60
50
40
30
Fahr. Temperature Line
Wet-Bulb Line
(Tendency)
10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Wet Bulb Temperatures
Fahr. Temperatures

FIG. 1 EFFECT OF TEMPERATURE ON DEATH RATE
Data from Champaign County, Ill., Weather and Death Records, 1914-23

The effect of climate on health and mental and physical aggressiveness is well known. Climate is weather over a long period, and to maintain ideal weather indoors is the object of ventilation. Adverse atmospheric conditions are reflected in a decreased capacity for doing work. Good weather promotes good health, good health promotes efficiency, and efficiency promotes production. Fig. 1 shows clearly the effect of temperatures on health and emphasizes the importance of maintaining ideal indoor weather conditions. "It has been found that even when men were urged to work, they accomplished 28 per cent less total work in a day in an atmosphere 86 deg. fahr., 80 per cent relative humidity, than at 68 deg. fahr., 50 per cent relative humidity."[1] J. I. Lyle, General Manager of the Carrier Engineering Corporation, states that, by providing proper ventilation, "in many instances the production is increased as much as 10 per cent and in a few instances as much as 15 per cent to 18 per cent due to speeding up of labor alone."[2] The Industrial Fatigue Board of England reports a maximum seasonal fluctuation in output of 30 per cent below normal for the hot summer months in some instances. These accounts do not record the expense occasioned by absence of employees, and labor turnover occasioned by disability from this cause.

Air conditioning is necessary to modify normal weather conditions, to overcome vitiation of the air, to provide for a lack of natural ventilation, and to facilitate or make possible the carrying on of industrial processes affected by atmospheric conditions. It implies control of the temperature, humidity, purity and distribution of the air.

Bad Effects of Poor Ventilation

The adverse effects which may be experienced because of poor ventilation are: (1) Headache; (2) mental lassitude; (3) physical sluggishness; (4) fatigue; (5) cold; (6) excessive warmth; (7) abnormal reaction of the mucous membranes of the nose and throat, with resulting nervousness or susceptibility to infection; (8) unpleasant odors; and (9) decreased appetite. These effects result in a diminished capacity for doing work. Continued exposure to the conditions brings about a marked lowering of mental and physical vigor. Partial disability, absences, more accidents, a poorer quality of production and an abnormal death rate follow, and increase production costs.

The fact that workers will accustom themselves to unsuitable atmospheric conditions without protest does not minimize the harm done and should not be an excuse for their continuance. Weeks and even months may elapse before injurious effects demonstrate them-

[1] "Ventilation," New York State Commission on Ventilation, 1923, p. 196.
[2] From a personal letter to the writer dated June 26, 1924.

selves. Fortunately, apart from the social considerations involved, the cost of securing good ventilation will usually pay dividends in immediate increases in production.

Air may be deficient as regards: (1) Temperature; (2) humidity; (3) carbon dioxide content; (4) presence of dust or fumes; (5) presence of bacteria; (6) odors; (7) lack of movement; and (8) lack of variability. Standards of ventilation have been formulated which are designed to eliminate these possible adverse conditions.

STANDARDS OF VENTILATION[3]

1. Effective air supply—the proper introduction, distribution and disposal of an adequate quantity of air.
2. Effective air temperature, considering temperature, humidity and motion of the air.
3. Air cleanliness.
4. Air sanitation.
5. Odors.
6. Other injurious substances.
7. Monotony.

Industrial ventilation systems are most frequently designed to supply 3000 cu. ft. of air per hr. per occupant,[4] but this may and should vary depending upon conditions. The quantity of air introduced should be governed by the amount needed to maintain the quality standard. An average adult gives off 400 B.t.u. per hr.—when actively at work, nearly twice this number. Enough air must be supplied to prevent the temperature from rising above the figure indicated for comfort and efficiency. This will usually vary between 60 and 68 deg. fahr., according to the character of work being done.[5]

[In determining the volume, temperature and humidity of the incoming supply] every source of heat, such as the friction of machinery, the lights, the number of occupants themselves, heated mechanical apparatus, like cooking kettles, or open pans from which water can be evaporated, the sun's heat effect, the leakage of air inward or outward, must be carefully considered and the apparatus designed accordingly. The exposures of the building, the materials of which the walls, floors, and ceilings are made, the contents of the various floors, the presence of materials which absorb or give up moisture—all these things must be computed.[6]

Also, air which is vitiated by processes, or drawn out in removing dust, fumes, heat or waste, must be replaced.

As the temperature of air is increased, the relative humidity percentage should become lower in order that the evaporative effect on the body may be greater. (See Fig. 2.) Considering health and comfort, the relative humidity should be maintained between 35 or 40 per cent and 80 per cent, at a figure which in combination with the desired thermometer reading will give an ideal wet bulb reading of from 57 to 60.[7] The vapor content of the air may also be taken as a partial measure of its quality. A content of from 4 to 5 grains per cubic foot is considered satisfactory with a permissible variation between 3 and 7 grains for a part

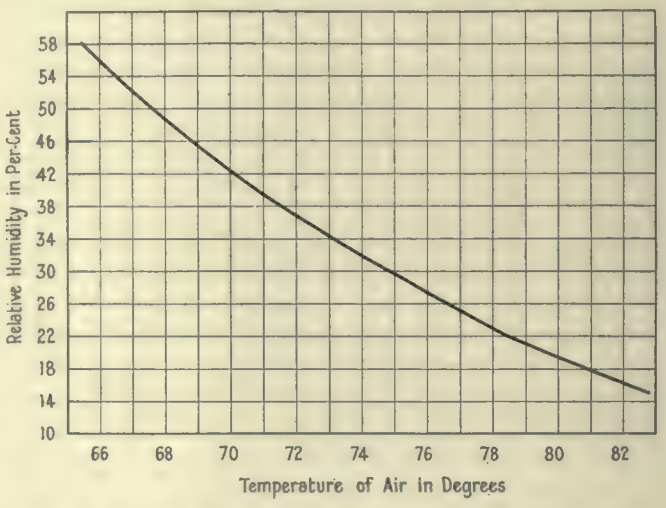

FIG. 2 PROPER HUMIDITIES FOR DIFFERENT TEMPERATURES

of the time.[8] Air must also be comfortable to work in and this standard is expressed in "effective temperatures" coming within the "comfort zone" as determined by tests. Thus, air in order to satisfy the requirements of health, comfort and working efficiency must offer a proper combination of temperature, humidity, wet bulb reading, moisture content and effective temperature.

Table 1 was prepared from a psychrometric chart, and other data. It shows the resultant wet bulb readings, vapor content and effective temperature of air with various combinations of temperature and moisture content and at different velocities.

Nature does not offer ideal combinations at all times,

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[3] "Modern Trend in the Science of Ventilation," Perry West, Journal of the American Society of Heating and Ventilating Engineers, v. 30, no. 6, pp. 421-438.

[4] This may vary from 1200 cu. ft. per hr. to air changes every 3 or 4 min. in such places as laundries, kitchens, boiler and engine rooms, galvanizing rooms, dye-rooms, etc.

[5] ". . . The most important result of our experiments has perhaps been the demonstration that even moderately high temperatures . . . between 75 and 86 deg. fahr., are accompanied by demonstrable harmful results [to health]. An increase of room temperature from 68 deg. fahr. to 75 deg. fahr. caused a decrease of 15 per cent in the physical work performed by men who were not compelled to maximum effort but were stimulated by a cash bonus." "Ventilation," New York Commission on Ventilation, p. 196.

Temperatures below 48 and above 68 deg. fahr. are detrimental to both health and efficiency. Temperatures between 55 and 65 deg. fahr. are better.

[6] "Weather," Carrier Engineering Corporation, p. 16.

[7] Wet bulb readings ranging between 48 to 66 do not result in abnormal death rates, but maintenance of the condition suggested above will tend to reduce the death rate below normal.

Other conditions permitting, relative humidity percentages of from 40 to 60 per cent will ordinarily be used. In the temperature of 90 deg. and a relative humidity of 30 per cent, four times more work was performed than in air at the same temperature and 100 per cent relative humidity. Five times more work was performed in a temperature of 90 deg., relative humidity 60 per cent, than in a temperature of 120 deg. and the same relative humidity. Work could be performed efficiently in air of 100 deg. fahr. and a relative humidity of 30 per cent. "Still and Moving Air," W. J. McConnell and C. P. Yagloglou, Journal of American Society of Heating and Ventilating Engineers, v. 31, no. 1, pp. 59-70.

[8] The less moisture, the lower the dew point, and consequently the lower the possible temperature of walls without condensation.

TABLE 1. EFFECTIVE AIR TEMPERATURES AT VARYING VELOCITIES UNDER DIFFERENT THERMOMETER TEMPERATURES AND HUMIDITIES

Temp. Fahr.[1]	Rel. Hum.[2]	Dew Point[3]	Outdoor Temp.[4]	Wet Bulb[5]	Grains of Water Vapor[6]	Still Air	Effective Temperatures[7] at Various Velocities per Minute		
							100′	300′	500′
75	100	75.0	75.0	75.0	9.4	75.0	73.2	69.8	67.3
	70	64.4	61.0	67.9	6.6	71.8	70.2	67.2	65.0
	60	60.0	55.0	65.3	5.6	70.9	69.3	66.4	64.4
	50	55.0	48.0	62.6	4.7	70.0	68.5	65.7	63.8
	40	48.5	39.0	59.8	3.8	69.1	67.6	65.0	63.2
	30	41.1	28.0	56.6	2.8	68.2	66.9	64.4	62.7
	20	30.1	15.0	53.2	1.9	67.4	66.1	63.7	62.2
70	100	70.0	70.0	70.0	8.0	70.0	67.9	63.8	61.0
	90	67.0	66.0	67.9	7.3	69.1	67.1	63.1	60.5
	85	65.2	64.0	66.8	6.8	68.7	66.7	62.7	60.2
	80	63.5	61.0	65.8	6.4	68.3	66.3	62.4	60.0
	70	59.5	56.0	63.4	5.6	67.4	65.5	61.8	59.5
	60	55.2	50.0	61.0	4.8	61.7	64.9	61.3	59.0
	50	50.2	43.0	58.5	4.0	66.0	64.3	60.9	58.6
	40	44.4	36.0	55.9	3.2	65.3	63.6	60.4	58.3
	30	36.7	26.0	53.0	2.4	64.7	63.0	60.0	57.9
	20	27.3	13.0	50.0	1.6	64.0	62.5	59.5	57.5
68	100	68.0	68.0	68.0	7.5	68.0	65.7	61.2	58.4
	90	65.0	64.0	66.0	6.8	67.2	65.0	60.7	58.0
	85	63.0	61.0	65.0	6.4	66.8	64.7	60.4	57.8
	80	61.5	59.0	63.9	6.0	66.4	64.2	60.2	57.6
	70	57.5	54.0	61.6	5.3	65.7	63.7	59.7	57.3
	60	53.2	48.0	59.2	4.5	65.0	63.0	59.3	56.9
	50	48.5	42.0	56.9	3.8	64.4	62.5	58.8	56.5
	40	42.4	34.0	54.3	3.0	63.8	62.0	58.4	56.2
	30	35.0	24.0	51.3	2.3	63.2	61.4	58.0	55.9
	20	25.7	11.0	48.6	1.5	62.6	60.9	57.7	55.6
66	100	66.0	66.0	66.0	7.0	66.0	63.5	58.7	55.8
	90	63.0	62.0	64.0	6.4	65.3	62.9	58.3	55.5
	85	61.3	59.0	63.0	6.0	65.0	62.6	58.1	55.4
	80	59.5	57.0	62.0	5.7	64.7	62.3	57.9	55.2
	70	55.6	52.0	59.8	5.0	64.0	61.7	57.5	54.9
	60	51.4	46.0	57.5	4.2	63.4	61.2	57.1	54.6
	50	46.9	41.0	55.2	3.5	62.8	60.7	56.8	54.4
	40	40.8	32.0	52.8	2.8	62.2	60.2	56.5	54.1
	30	33.2	22.0	50.1	2.1	61.7	59.8	56.2	53.9
	20	24.3	10.0	47.3	1.4	61.1	59.4	55.9	53.7
64	100	64.0	64.0	64.0	6.6	64.0	61.3	56.2	53.1
	90	61.0	60.0	62.1	6.0	63.4	60.8	56.0	52.9
	85	59.4	58.0	61.1	5.6	63.0	60.6	55.8	52.8
	80	57.5	55.0	60.1	5.3	62.8	60.3	55.7	52.7
	70	54.0	51.0	58.0	4.6	62.2	59.8	55.3	52.6
	60	49.7	45.0	55.8	4.0	61.7	59.4	55.0	52.4
	50	45.0	39.0	53.6	3.3	61.1	59.0	54.7	52.2
	40	39.0	31.0	51.1	2.6	60.7	58.6	54.5	52.0
	30	31.7	21.0	48.5	2.0	60.2	58.2	54.3	51.9
	20	23.0	9.0	46.0	1.3	59.7	57.8	54.0	51.7
62	100	62.0	62.0	62.0	6.1	62.0	59.1	53.8	50.5
	90	59.1	57.0	60.2	5.6	61.4	58.7	53.6	50.3
	85	57.2	55.0	59.2	5.3	61.1	58.4	53.5	50.2
	80	55.7	54.0	58.3	5.0	60.9	58.2	53.2	50.2
	70	52.2	49.0	56.1	4.3	60.4	57.8	53.0	50.1
	60	47.9	43.0	54.0	3.7	60.0	57.5	52.9	50.0
	50	43.0	37.0	52.0	3.1	59.6	57.2	52.7	50.0
	40	37.0	29.0	49.6	2.5	59.1	56.8	52.5	49.9
	30	30.0	19.0	47.1	1.9	58.7	56.5	52.3	49.8
	20	21.8	8.0	44.7	1.2	58.3	56.2	52.1	49.6
60	100	60.0	60.0	60.0	5.7	60.0	56.9	51.3	47.8
	90	57.0	56.0	58.2	5.2	59.6	56.5	51.1	47.8
	85	55.3	54.0	57.3	4.9	59.3	56.4	51.0	47.8
	80	53.9	52.0	56.4	4.6	59.1	56.2	51.0	47.8
	70	50.1	47.0	54.3	4.1	58.7	55.9	50.9	47.8
	60	46.0	41.0	52.2	3.5	58.3	55.6	50.7	47.7
	50	41.2	35.0	50.3	2.9	57.9	55.4	50.6	47.7
	40	35.2	27.0	48.0	2.3	57.5	55.2	50.4	47.7
	30	28.9	18.0	45.8	1.7	57.2	54.9	50.3	47.6
	20	20.0	7.0	43.3	1.1	56.9	54.6	50.2	47.6
56	100	56.0	56.0	56.0	5.0	56.0	52.4	46.2	42.4
	90	53.3	52.0	54.3	4.6	55.7	52.2	46.2	42.5
	85	51.5	50.0	53.4	4.3	55.5	52.2	46.2	42.6
	80	50.1	48.0	52.6	4.0	55.4	52.1	46.2	42.7
	70	46.2	43.0	50.8	3.5	55.1	51.9	46.2	42.8
	60	42.4	38.0	48.8	3.0	54.9	51.8	46.2	42.9
	50	38.0	32.0	47.0	2.5	54.7	51.7	46.2	43.0
	40	32.0	24.0	45.0	2.0	54.4	51.5	46.2	43.1
	30	25.0	14.0	42.9	1.5	54.1	51.3	46.2	43.2
	20	17.0	4.0	40.8	1.0	53.9	51.2	46.2	43.2

1. The usual temperature range for health and comfort is between 60 and 68 deg. fahr. In some instances higher temperatures might be preferable in order to avoid too great a contrast between outdoor and indoor conditions. A condition of comfort can be maintained even at much lower or higher dry bulb temperatures by properly controlling the humidity and velocity of the air.

2. The humidity percentage should vary somewhat according to the temperature, in general being lower at high temperatures and vice versa, ranging from 35 or 40 per cent to 70 or possibly 80 in some cases. In summer a close relation should exist between outdoor and indoor conditions in order that too great a contrast may be avoided. A condition of comfort can be maintained with lower or higher relative humidity percentages by properly controlling the temperature and velocity of the air.

3. This is the temperature at which condensation would take place. With high relative humidity percentages indoors and low temperatures outdoors, glass and wall area temperatures may easily be so low as to cause objectionable condensation. This reason, combined with the difficulty of evaporating sufficient water, is why in house heating the humidity of the air is usually about 30 per cent or even less.

4. These or lower temperatures outdoors, with corresponding dry bulb and relative humidity readings would result in glass temperatures (inside of windows) as indicated under "Dew Point," and condensation would result.

5. Wet bulb readings may vary between 48 and 66, ideal readings coming between 57 and 61, the lower figure being preferable for the summer months when less clothing is worn. The effect of wet bulb readings on comfort may be modified by properly controlling the velocity of the air.

6. The usual water content should probably be from 4 to 5 grains, with permissible variations between 3 and 7 grains per cu. ft. of air. See footnotes 10 and 11 on page 442.

7. Effective temperature readings between 63 and 71 come within the "comfort zone" considering individuals normally clothed and at rest in still air.

and variability is an essential to an invigorating climate. In many instances the expense of equipment to control absolutely the air supply will not be justified. However, low humidities have harmful effects and cold air introduced into the work place and merely warmed may be very deficient in moisture. For example, air at zero deg. fully saturated will contain but one-half grain of water vapor per cu. ft. When heated to 70 deg. without adding moisture, its relative humidity would be but 6¼ per cent.

Air in motion at ordinary temperatures is cooling in its effect, and to a greater degree as its velocity is increased, although low velocities are more efficient than high.[9] The effective temperature differences

[9] In practice velocities greater than 300 ft. per min. are seldom used.

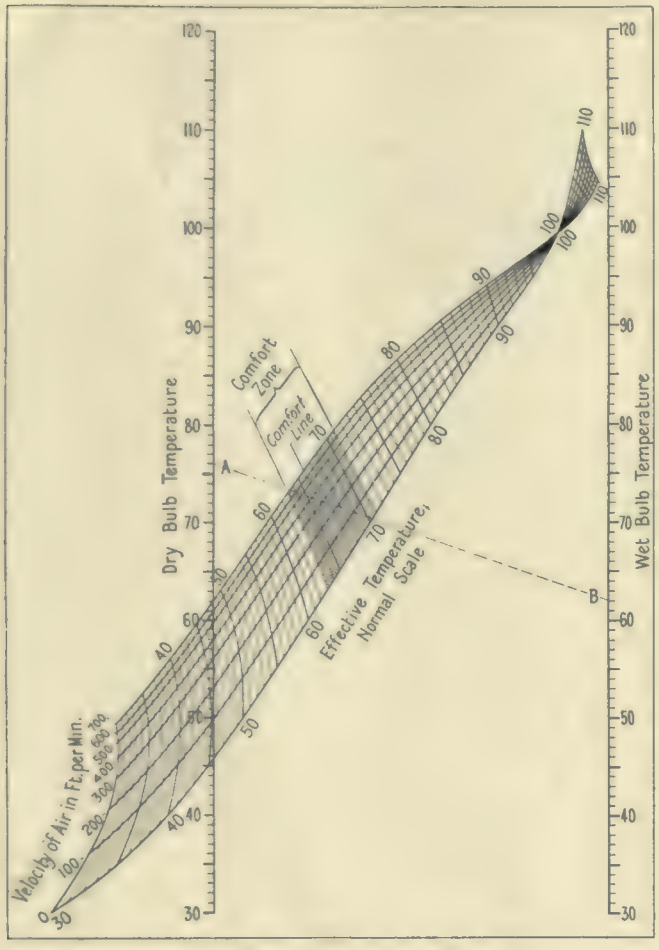


FIG. 3 THERMOMETRIC CHART

Developed by C. P. Yagloglou and W. Edw. Miller for human beings at rest and normally clothed. A. S. H. V. E. Research Laboratory in co-operation with the Bureau of Mines.

Fig. 3 "affords a complete formulation of the laws of cooling of the human body. The proximity of any point to the dry and wet bulb axes indicates the superiority of one temperature over the other in determining human comfort. For ordinary temperatures the points are nearer to the dry bulb axis, while for high temperatures, when sensible evaporation comes into play, the upper part of the diagram approaches the wet bulb axis.

"In the lower part of the diagram the various velocity lines intersect the dry bulb axis at temperatures at which the effect of wet bulb, or humidity of the air, is eliminated completely. Below these temperatures the divergence of the velocity lines away from the dry bulb axis and the change in their curvature indicate a reversal in the effect of humidity; the higher the humidity the cooler the condition, and vice versa.

"At high temperatures the velocity curves converge, until at body temperature they meet at a point called the 'neutral point' in atmospheric conditions. Above this point the reversal in the order of the velocity curves with reference to the still-air curve shows the heating effect of wind upon the human body, and its increase with velocity. . . . The distance between any two velocity lines is a function of the amount of cooling produced by an increase of 100 ft. per min. in the velocity of the air. Above 300 ft. per min. the efficiency of air movement falls off considerably, and it will be inefficient to use velocities greater than this."[10]

The following example illustrates the use of the chart: Given dry bulb 76 deg., wet bulb 62 deg., velocity of air 100 ft. per min., determine:

1. Effective temperature of the condition.
2. Effective temperature with still air.
3. Cooling produced by the movement of the air.
4. Velocity necessary to reduce the condition to 66 deg. effective temperature.

1. Draw line A-B through given dry and wet bulb temperatures. Its intersection with the 100 ft. velocity curve gives 69.0 deg. for the effective temperature of the condition.

2. Follow line A-B to the right to its intersection with the o velocity line, and read 70.4 deg. for the effective temperature with still air.

3. The cooling produced by the movement of the air is 70.4 — 69.0 deg. = 1.4 deg. effective temperature.

4. Follow line A-B to the left until it crosses the 66 deg. effective temperature line. Interpolate velocity value of 340 ft. per min., to which the movement of the air must be increased for maximum comfort.

By passing this air through a humidifier where the water is recirculated and not heated, the dry bulb temperature will be reduced to 62 deg., the wet bulb temperature. A line connecting the two 62 deg. points on the respective scales will pass through the effective temperature line at 62 deg.—8.4 deg. lower than before. The cooling effect of moving the air at a rate of 100 ft. per min. will then be 3.0 deg. as compared with 1.4 deg. previously. When air at high temperatures and low or moderate humidities can be treated in this manner there is a considerable advantage in doing so.

For an effective temperature of 65 deg., and with 20 per cent relative humidity, the wearing of normal clothing requires a lower dry bulb temperature by 3.3 deg., than when subjects are stripped to the waist. This difference decreases as the effective temperature rises, until at 94 deg. it is immaterial whether clothing is worn or not. In industrial operations that require exposure to high temperatures and low humidities workers will be cooler if their entire bodies are covered with clothing.[11]

between still air and moving air are greater the greater the degree of saturation. These facts are apparent by reference to Table 1 and Fig. 3. As long as the wet bulb temperature of the air is below the body temperature a cooling effect is exerted, but when above, an opposite effect is felt.

Frequently it is possible to secure a considerable cooling effect by providing simple and inexpensive equipment to put the air in motion, but if the air temperatures are high, this remedy may not prove sufficient. At high temperatures, the cooling effect of air even at high velocities is small, and it may prove economical first to saturate the air, thus reducing its temperature, in order to get greater effect. If the air has high relative humidity the cooling effect by air washing is smaller than if the air has initially a smaller moisture content.

(To be concluded in the June issue.)

[10] "Effective Temperature with Clothing," C. P. Yagloglou and W. Edw. Miller, Journal of American Society of Heating and Ventilating Engineers, v. 31, no. 1, pp. 59-70.

[11] *Ibid.* Heat losses occur due to radiation, convection and evaporation. As the body temperature is approached, those by radiation and convection approach zero, while due to perspiration, the evaporative heat losses increase and are made greater by the greater area of clothing surface as compared with body surface.

Cost Finding System for Garments

Characteristics Are: Simplicity, Easily Installed, Has Few Original Records, Adapted to Small Plant

By C. G. DAUGHTERS

The Van Wert Overall Manufacturing Company

IN 1920, the International Garment Manufacturers' Association initiated among its members a plan of standardized cost figuring for their industries. It was recognized by the Board of Directors and by the membership itself that there was a tremendous discrepancy in the costs of a standard garment manufactured by a group of competitive manufacturers that could be accounted for only in one way, namely, that there was no common method of cost figuring among them. The fact was obvious that a large number of the members did not know their true costs and were therefore laboring under a handicap that was damaging to their own individual welfare. Standard cost finding was recognized as being beneficial not only to the individual manufacturer but also to the industry as a whole.

It is possible by means of books and written instructions for an accountant having some knowledge of cost finding to install a cost system. It is proposed here to explain such a system as adapted to a garment manufacturing industry.

Most small plants have a general accounting system comprised ordinarily of a general ledger and books of original entry. The general ledger usually consists of the asset, liability, income, and expense accounts, a page or series of pages being reserved for each account on which are posted the proper entries from the books of original entry. The books of original entry may be comprised of a cash received record, a check drawn record, an invoice register, and a journal.

As mentioned before, most small manufacturing concerns have some or all of these rudiments of accounting. Frequently, with little additional time and effort involved, a cost system may be evolved out of these rudiments that will secure for the management an accurate knowledge of costs; a prearranged budget of expense; a predetermined or normal cost per lot or garment manufactured; a correct distribution of overhead expense; knowledge of abnormal gains or losses due to increased production or shut-downs, and good or bad buys of material; and will permit the allocation of these gains or losses to particular departments and expense items.

The first essential in developing such a cost system is the proper distribution of expense items. This may be most easily handled by means of a chart of accounts. Each expense account is arranged in its proper sequence and given a designating number. For purposes of illustration, the chart of accounts shown in Table 1 is provided as applying to a small factory.

Using this chart of accounts as a basis, a budget of expenses can be set up for each department. These are divided into fixed expenses, or expenses which can be determined for the period for which the budget is set up. This period usually does not exceed six months, and the fixed expenses are such as taxes, insurance, depreciation, and fixed salaries for supervision. The second division of expenses includes those which cannot be foretold with any great degree of certainty and must therefore be estimates based on past records. Repairs, power, non-productive labor, light, heat, water, general expense, etc., come under this head.

TABLE 1. CHART OF ACCOUNTS

Account Number	Name of Account
	Building Department
50	Janitor Services
51	Repair to Buildings
52	Fuel
53	Water
54	Light
55	Janitor Supplies
56	Miscellaneous Janitor Supplies
	Office-Manufacturing Department
60	Executive Salaries
61	Clerical
62	Stationery and Supplies
63	Professional Expenses
64	Miscellaneous Expenses
	Office-Selling Department
70	Executive Salaries
71	Clerical
72	Sales Promotion
73	Advertising
74	Commissions
75	Salesmen's Salary and Expense
76	Postage
77	Stationery and Supplies
78	Telegrams and Telephones
79	Miscellaneous Expense
80	Legal Expenses
	Shipping Department
85	Shipping Labor
86	Shipping Supplies
87	Drayage
88	Prepaid Shipments
	Cutting Department
90	Freight and Express In
91	Cutting Supplies
92	Non-productive Labor
93	Cutting Labor
	Making Department
95	Supervision
96	Non-productive Labor
97	Power
98	Repair to Machinery
99	Supplies
100	Productive Labor

Certain expenses of both of the above groups can be allocated directly to each department. The fixed charges, taxes, insurance, and depreciation must be prorated. The amount apportioned to each department is based on the value of the equipment and stock made use of directly by each department. Such distribution is made as shown in Table 2.

The next step is to complete the budget for each

department. Starting with the building department, which affects all other departments, the total direct expense is determined, to which are added the fixed charges apportioned from Table 2. The total building department expense is now prorated to the remaining departments which make use of the building. (See Table 3.) Unless there is some obvious reason in particular cases for doing otherwise, this prorating is done on the basis of the floor space used by each department.

TABLE 2. DISTRIBUTION OF FIXED CHARGES

Department	Depreciation	Taxes	Insurance	Yearly Total	Monthly Total
Building	$ 300.00	$300.00	$240.00	$ 840.00	$ 70.00
Office-mfg.	48.00	6.00	6.00	60.00	5.00
Office-selling	75.00	15.00	6.00	96.00	8.00
Shipping	60.00	60.00	204.00	360.00	30.00
Cutting	42.00	18.00	60.00	120.00	10.00
Making	1,020.00	60.00	102.00	1,182.00	98.50
Yearly total	$1,545.00	$495.00	$618.00	$2,658.00	.....
Monthly total	$ 128.75	$ 41.25	$ 51.50	.....	$221.50

The second department affecting all others may be designated as the office-manufacturing, as differentiating from the office-selling department. The office-manufacturing department budget is made up in the same way and prorated to the producing departments on the basis of the office work performed for each department.

TABLE 3. BUILDING DEPARTMENT
For the month of March

Account Number	Name	Normal	Actual	Month to Date
50	Janitor Services	$ 40.00	$ 40.00	$120.00
51	Repair to Building	20.00	10.00	50.00
52	Fuel	25.00	25.00	75.00
53	Water	10.00	.....	25.00
54	Light	8.00	10.00	30.00
55	Janitor Supplies	10.00	15.00	25.00
56	Miscellaneous Expense	5.00	4.00	12.00
	Total direct expense	$118.00	$104.00	$337.00
	Share of:			
	Depreciation	25.00	25.00	75.00
	Taxes	25.00	25.00	75.00
	Insurance	20.00	20.00	60.00
	Total building expense	$188.00	$174.00	$547.00
	Distribution:			
	Office-mfg. dept.—1/10 of total	$ 18.80	$ 17.40	$ 54.70
	Office-selling dept.—1/10 of total	18.80	17.40	54.70
	Shipping dept.—1/5 of total	37.60	34.80	109.40
	Cutting dept.—1/5 of total	37.60	34.80	109.40
	Making dept.—2/5 of total	75.20	69.60	218.80
	Total distribution	$188.00	$174.00	$547.00

The budget for the office-selling department is now determined and an estimated monthly sales item is set up. (See Table 4.) The ratio of the total selling expenses to the estimated sales gives a percentage figure that is used in figuring the selling cost of an individual garment or lot.

The budget for the shipping department is now established and a normal quantity to be shipped each month is determined. By dividing this quantity into the total shipping department expense, a normal cost per dozen or per unit can be determined with which the actual cost from month to month may be compared.

TABL E 4. OFFICE-SELLING DEPARTMENT
For the month of March

Account Number	Name	Normal	Actual	Month to Date
70	Executive Salaries	$ 500.00	$ 500.00	$ 1,500.00
71	Clerical Expense	300.00	295.00	875.00
72	Sales Promotion	100.00	185.00	345.00
73	Advertising	200.00	300.00	700.00
74	Commissions	1,800.00	2,400.00	7,000.00
75	Salesmen's Traveling Expense	200.00	75.00	125.00
76	Postage	25.00	35.00	95.00
77	Stationery and Supplies	90.00	65.00	250.00
78	Telegrams and Telephones	20.00	15.00	50.00
79	Miscellaneous Expense	10.00	2.00	5.00
80	Legal Expense	10.00		
	Total direct expense	$ 3,255.00	$ 3,872.00	$ 10,945.00
	Share of:			
	Fixed charges	8.00	8.00	24.00
	Building dept. expense	18.80	17.40	54.70
	Total selling expense	$ 3,281.80	$ 3,897.40	$ 11,023.70
	Sales	$30,000.00	$40,000.00	$117,000.00
	Ratio of expense to sales	10.9%	9.5%	9.4%

This completes the budget for all except the actual producing or manufacturing departments. Only one is given here, the cutting department. The stores department is included in the cutting department for purposes of simplification and also because, in the small factory, the cutting is generally done in that part of the building where the raw material is stored. The budget is made up for the cutting department in the same manner as for the preceding departments. The total expense is prorated to the garments cut on the basis of actual cutting labor done. If the cutting is on a piece-rate basis, this prorating is simplified. Otherwise, the cutting labor costs per lot or dozen garments must be determined as nearly as possible by actual inspection. The difference between the actual and estimated cutting labor cost can be determined from month to month as will be explained later.

TABLE 5. CUTTING DEPARTMENT
For the month of March

Account Number	Name	Normal	Actual	Month to Date
90	Freight and Express In	$230.00	$310.00	$ 785.00
91	Cutting Supplies	10.00	12.00	26.00
92	Non-productive Labor	18.00	20.00	50.00
	Total direct expense	$258.00	$342.00	$ 861.00
	Share of:			
	Fixed charges	10.00	10.00	30.00
	Building dept. expense	37.60	34.80	109.40
	Office-mfg. expense	62.76	56.68	174.14
	Total department expense	$368.36	$443.48	$1,174.54
93	Productive Cutting Labor	$260.00	$285.00	$ 810.00
	Ratio of expense to labor	141.6%	155.6%	145%
	Unit garments cut—dozen	2,600	2,750	7,700
	Cost per dozen to cut	$0.10	$0.104	$0.106

A standard garment is taken as a unit in terms of which the labor cost of all other garments is expressed. A normal monthly cutting production of the unit garment is determined. (See Table 5.) This quantity multiplied by the normal or estimated cutting labor

FINAL COST SHEET Date 4/1/25

Lot No. 100 Description Bib Overall

Description	Material Description	Unit Per Dozen	Price Per Unit	Amount
Piece Goods	2.20 Denim	40 yds.	20¢	$8. 00
Facing	2.20 Denim	2 yds.	20¢	.40
Pocketing	2.85 Drill	3 yds.	16¢	.48
Buttons	#16 – #18	7dz–3dz	2¢–3¢	.23
Buckles	#6	2dz.	5¢	.10
Elastic		4 yds.	7¢	.28
Bias Binding				
Thread				.40
TOTAL MATERIAL COST				$9. 89

No.	Department	Unit	Rate	Labor	Rate	Expense	Amount
	Cutting			10	141.6%	.14 plus	25
	Making			1 00	46%	.46	1 46
TOTAL MANUFACTURING COST							11 60

No.	Selling Cost	Unit	Rate	Amount
	Shipping			30
	Commissions		6%	87
	General Selling		4.9%	71
	Total			1 [illegible]
TOTAL SELLING COST				13 48

Remarks	Allowance for Loss on Seconds	
	Allowance for Discount	%
	Allowance for Interest	%
	Allowance for Gain on Extra Sizes	
Total Cost		13 48
Net Profit	%	1 02
Selling Price		14 50

FIG. 1 SHEET USED FOR DETERMINING SELLING PRICE

cost establishes a normal cutting labor expense per month. The ratio between cutting labor cost and cutting department expense provides a figure to be used in prorating to the individual garment the overhead of the cutting department.

The manufacturing department budget is made up in much the same manner as the cutting department budget. A normal monthly production is determined for the department. The piece-rate labor cost for the unit dozen is used in computing a normal productive labor item for the month. The ratio between this item and the total manufacturing department expense gives a figure to be used in prorating to the individual garments the overhead expenses of the manufacturing department.

The final cost sheet has for its purpose the determination of manufacturing and selling costs of the factory product in order to ascertain what the selling price of the product must be to yield a reasonable margin of profit.

The raw material going into the product can be ascertained without much difficulty. In the illustration used here, the manufacturing unit is a dozen lot. By tabulating the yardage from a number of cutting requisitions for a particular garment and dividing by the total dozen cut, an average or normal yardage per dozen can be ascertained. This yardage is set down on the final cost sheet and multiplied by the market price of the piece goods to arrive at the piece goods price per dozen. The cost prices of the trimmings, buttons, buckles, elastic, bias binding, etc., are determined in the same way. This establishes the total material costs per dozen. (See Fig. 1.)

The next step is to ascertain the cutting costs. For purposes of illustration, let us say that from actual inspection it is found that the normal cutting labor cost is 10 cents per dozen on a particular style of garment. From Table 5, the rate of overhead expense in the cutting department is 141.6 per cent. This gives a figure on the 10 cent labor cost of 14 cents plus, and a total cutting cost of 25 cents.

To determine the making costs, the total piece-rate labor on this garment is used as the labor cost on the final cost sheet. The manufacturing budget (not shown) gives a ratio of 46 per cent on the labor costs of the manufacturing department. Adding this to the labor costs, we have the total making costs. The sum total of the material, cutting, and making costs is the manufacturing cost of this garment in dozen lots. This is the price at which the garments are credited out of work in process and charged to finished product.

To complete the final cost sheet, Fig. 1, the shipping and selling costs are yet to be ascertained. The shipping department budget (not shown) gives the normal shipping cost as 30 cents. From Table 4, the selling cost is 10.9 per cent of the selling price. An estimated selling price of this garment is tentatively selected and the selling expenses of the garment ascertained. If the difference between the total shipping, selling, and manufacturing costs and the selling price does not allow a reasonable margin of profit, it follows that the selling price must be increased to the point where it does. This will complete the final cost sheet.

As stated before, the final cost sheet is based on normal manufacturing conditions. The expense ratios

ABNORMAL MATERIAL COST

For Month Ending March 192 5

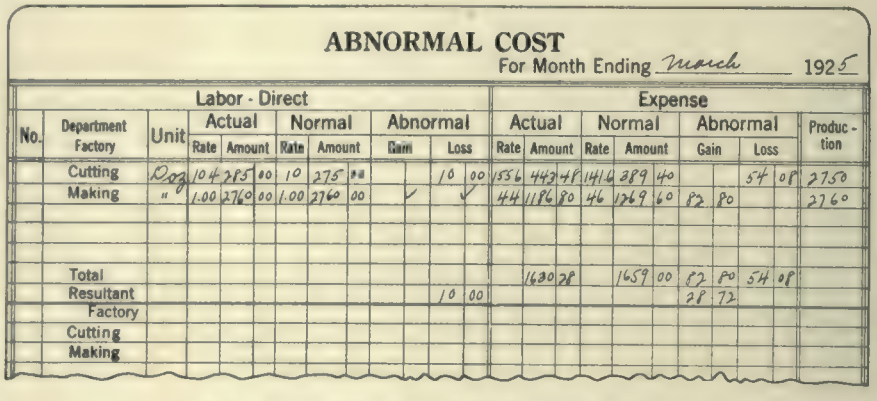
Lot No.	Garments Cut	Actual Consumption: Yards Used	Average per Doz.	Amount	Price Per Yard	Normal Consumption: Price Per Yard	Average per Doz.	Yards Required	Amount	Abnormal: Gain	Loss
100	200dz.	8200	41yds.	1640 00	20	20	40yds.	8000	1600 00		40 00
200	180	6400	30	1280 00	20	20½	30	6400	1312 00	32 00	
800	780	31590	40½	4738 50	15	15	40	31200	4680 00		58 50
250	600	23400	39	5148 00	22	21	40	24000	5040 00		108 00
80	500	13000	26	2860 00	22	23	26½	13250	3047 50	187 50	
90	500	13250	26½	2848 75	21½	22	26½	13250	2915 00	66 25	
235	400	8000	20	1680 00	21	21½	20	8000	1720 00	40 00	
300	300	6000	20	1260 00	21	20	20½	6150	1230 00		30 00
Total	3460	109840		21455 25				110250	21544 50	325 75	236 50
Resultant										89 25	

FIG. 2 FORM USED TO SHOW LOSSES OR GAINS FROM MATERIAL

are taken from a budget of manufacturing expenses set up for a definite period. The actual manufacturing expenses will vary from the budget during the period and, therefore, this difference must be shown from month to month and properly taken into account, to show on the books the actual value of the work in process. If the manufacturing costs are reduced below the estimated budget, it follows that there has been an abnormal gain which must be credited to profit and loss. If the manufacturing costs are higher, profit and loss must be charged with the value of the abnormal loss. Work in process is debited in the first case and credited in the second.

The following conditions may cause a difference between the estimated costs and the actual costs: Raw material prices may rise or decline; the actual yardage may vary from the normal because of large runs of sizes or lax marking of patterns, allowing a considerable waste in cutting; by increased demands on the manufacturing and cutting departments, the output may be increased over the normal production required by the budget; the departments may be put on part-time work, thus reducing the production below the normal; perhaps, because of some unforeseen reason, the manufacturing expenses have been increased during the period. All of these differences must be taken into account. This is done by means of charts known as "abnormal gains or losses on manufacturing and cutting costs," and "abnormal gains or losses on material costs."

The "abnormal gains or losses on material" chart is explained first. (See Fig. 2.) The chart is divided into two sections, showing actual cost and normal cost. The actual figures are obtained from the cutting requisitions for the month. Forms can easily be devised for the accumulation of these requisitions according to lot number. The totals are then carried forward to this chart. The normal material cost figures are taken from the final cost sheets for each lot number. If the total actual cost for each lot number on this sheet is less than the total normal cost, the difference is shown in the gain column. If it is greater, the difference is placed in the loss column. The cause of this difference can then be determined, for the average yardage, and the average cost of material is shown in each instance. The net result is now determined for the month and the proper credit or charge made to profit-and-loss and to work-in-process.



ABNORMAL COST

For Month Ending March 1925

No.	Department Factory	Unit	Labor - Direct								Expense						
			Actual		Normal		Abnormal				Actual		Normal		Abnormal		Production
			Rate	Amount	Rate	Amount	Gain		Loss		Rate	Amount	Rate	Amount	Gain	Loss	
	Cutting	Doz	10	285 00	10	275	28		10	00	556	443 48	1416	389 40		54 08	2750
	Making	"	1.00	2760 00	1.00	2760	00	✓		✓	44	1186 80	46	1269 60	82 80		2760
	Total											1630 28		1659 00	82 80	54 08	
	Resultant								10	00					28 72		
	Factory																
	Cutting																
	Making																

FIG. 3 SHOWS VARIATIONS IN PRODUCTION COSTS

The chart showing the abnormal gain or loss in manufacturing and cutting expense requires subsidiary charts in order to compute the actual cutting production in terms of the unit used in the budget. We have taken as a unit that garment which normally costs 10 cents per dozen to cut. The cutting labor of other garments will cost proportionately according to the time it takes to cut them. (See Table 6.)

TABLE 6. COMPUTATION OF UNIT DOZENS CUT IN TERMS OF STANDARD GARMENT

LOT NUMBER	CUTTING LABOR COST PER DOZEN	RATIO TO UNIT DOZEN
100	$0.10	1.0
200	0.75	0.75
800	0.10	1.0
250	0.09	0.9
80	0.06	0.6
90	0.07	0.7
235	0.05	0.5
300	0.083	0.83

Table 7 establishes the production of the cutting department as being 2754 unit dozens for the current month. Referring to Table 5, the actual cutting labor cost per unit dozen for the month was 10.4 cents. The normal was 10 cents. It is now a simple matter to ascertain the abnormal gain or loss on cutting labor as shown in Fig. 3. By computing the ratio of actual cutting labor expense against normal expense, the abnormal gain or loss on cutting expense is also determined as illustrated.

TABLE 7. DETERMINATION OF UNIT DOZENS CUT PER MONTH

LOT NUMBER	ACTUAL DOZENS CUT (from Fig. 2)	UNIT RATIO	EXPRESSED IN TERMS OF UNIT GARMENT
100	200	1.0	200
200	180	0.75	135
800	780	1.0	780
250	600	0.9	540
80	500	0.6	300
90	500	0.7	350
235	400	0.5	200
300	300	0.83	249
...	3,460	.....	2,754

The final step is to learn the abnormal gain or loss in the manufacturing department. It is then only necessary to make the proper journal entries in order to adjust the work-in-process and profit-and-loss accounts in the books.

The results obtained may be summed up briefly as follows: The final cost sheets provide the management with the costs under normal manufacturing conditions; actual conditions can be checked against normal conditions; any abnormal change in costs can be charged to the department and to the particular expense items in which it occurred; any profits or losses accruing to good or bad buys of material can be definitely determined; it makes possible a reasonable basis for bonuses to department heads, provides a budget system, and permits a fairly accurate predetermination of costs.

Savings Through Management in Rubber Industry

By SANFORD E. THOMPSON and WILLARD E. FREELAND

President, The Thompson and Lichtner Co., Inc., Engineers

Assistant Professor of Marketing Massachusetts Institute of Technology

THE rubber industry is another of the great industries which have hugely increased in the last few decades. The use of rubber is being extended into new fields every year. It has many fairly distinct branches, although it is quite usual for one company to engage in two or more of the branches. The more important of the subdivisions are tires and tubes, footwear, belting and hose, hard rubber products, and rubberized fabrics.

The growth of the tire business is a particularly good example of the ability of industry to satisfy a new demand. In the figures given in Table 1 from census reports, the value of tires and tubes for 1919 was $752,926,708.

TABLE 1. RUBBER TIRES, TUBES, AND RUBBER GOODS
(Excluding footwear, belting and hose)

Year	Establishments	Wage-Earners	Capital	Value of Products
1909.....	227	26,528	$98,507,000	$128,436,000
1914.....	301	50,220	199,183,000	223,611,000
1919.....	437	119,848	782,638,000	987,088,000

The growth of the boot and shoe branch of the industry, one of the oldest subdivisions, was steady and consistent until 1914, but a sharp increase occurred in the next 5-year period. (See Table 2.)

It will be noticed from Tables 2 and 3 that there is a decided concentration in large plants with a corresponding increase in the need for more scientific methods than have as yet been generally adopted.

A combination of factors, including the great growth in the production of crude rubber, the depression in Europe, and the activities of certain nations in the governmental control of rubber production and marketing has caused wide fluctuations in the price of crude rubber. The drop in 1921, occurring as it did when most companies held large stocks of crude rubber, caused the liquidation of some companies and serious financial difficulties in several others.

TABLE 2. RUBBER BOOTS AND SHOES

Year	Establishments	Wage-Earners	Capital	Value of Products
1879.....	9	4,662	$2,425,000	$9,706,000
1889.....	11	9,134	17,791,000	18,632,000
1899.....	22	14,391	33,668,000	41,090,000
1909.....	22	17,612	43,905,000	49,721,000
1914.....	23	18,687	46,051,000	53,822,000
1919.....	25	32,875	131,513,000	116,917,000

TABLE 3. RUBBER BELTING AND HOSE

Year	Establishments	Wage-Earners	Capital	Value of Products
1889.....	17	1,835	$5,270,000	$5,513,000
1899.....	18	1,771	5,494,000	6,109,000
1909.....	18	5,131	19,732,000	19,238,000
1914.....	18	5,115	22,437,000	23,561,000
1919.....	15	5,826	26,299,000	34,211,000

A fundamental engineering problem, because of this price fluctuation and the length of time between production and consumption, is the forecasting of probable demand for and price of crude rubber on the one hand, and of demand for products on the other. The necessity for study of the fundamental laws of economics and their practical application is accentuated in the rubber industry, particularly statistical analysis of the effect of the business cycle.

Since the depression of 1921, many rubber manufacturers have cut their inventories. One large company, for example, accustomed to carrying seven months' supply of rubber, is now working on a two and one-half months' basis, thus increasing its turnover several times.

The forecasting of market demand and prices is more complex in the rubber industry than in most industries. Readily available statistics of cars produced and in use make it possible to estimate fairly well the demand for tires and tubes, but even here the advancing technique of the industry and the spread of good roads are introducing factors concerning the length of service of tires and tubes which make old sales figures less valuable.

The sale of rubber footwear is dependent upon seasons and weather. It is not at all uncommon for the companies in this branch of the industry to carry over large inventories of footwear from one winter to the next. In order to smooth out the production curve and help to stabilize the business, many of these companies are energetically pushing sales of canvas and rubber shoes for summer wear. The sale of rubber belting is much affected by business conditions, and the sale of rubber hose by dry seasons.

With many rubber products there is involved a factor of service which introduces a difficult problem of business policy. The result is that many branches of the industry find it necessary to take over most of the work of distribution, with the accompanying need of a large investment of capital and close sales control.

Problems of Processing

The rubber industry is so new that radical changes are being made continually in machinery and equip-

ment. Scarcely two manufacturers of tires, for example, have identical tire-building methods. Much is still being done by hand that eventually will be handled by machinery. Operations, now independent, with consequent moving from machine to machine, will eventually be made continuous.

Even in the composition of rubber compound, improvements are being made almost daily with a view to longer life, cost reduction, and standardization. Each manufacturer has his own formulas and the variations among them are large and important from the cost standpoint. A portion of the manufactured rubber is reclaimed for re-use in rubber products.

Rubber latex, that is, the milk or sap of the rubber tree, is now being imported in a colloid solution. With the perfection of a process for concentrating and purifying by removal of unstable compounds, a solution of substantially pure rubber is available.[1] The use of inflammable and dangerous solvents is thus avoided. The product is free from the deteriorating influence of unstable compounds and is destined for large application. Further changes in processing will result and entirely new products appear. This is typical of the opportunity for fundamental research in the industry.

Radical improvements in process, however, can only be brought about satisfactorily by thorough analysis of present methods and scientific evolution of new. In one plant, in certain processes of drying, it was found possible through research and analysis to effect savings of some $200,000 a year in steam consumption. In the same plant, the time consumed in certain processes was reduced 30 per cent.

That large strides have been made in economical production is evidenced by the price reduction in tires between 1920 and 1924. In the latter year, the prices were less than before the war and the wearing qualities were nearly double. While due in part to the drop in price of crude rubber, it is evident that the unit cost of labor and overhead has been cut down considerably, since in tires the cost of rubber is a little less than 23 per cent of the total manufacturing cost and the cotton content has radically increased in price.

Control of Production

The type of planning and control required in a rubber plant must necessarily vary with the product. In one instance, in a rubber shoe plant, it was found possible, by a development of control of the stock through the calendering operation, actually to increase production some 23 per cent with a large reduction in cost.

The attack on this problem was first to secure the available data on:

1. Present and future products to be manufactured by the company.
2. Careful analysis of the product with respect to construction.
3. Division of the product into major units and subdivision of these into smaller units.
4. Careful study of the operations to be performed on each unit.
5. Arrangement of these operations in their proper sequence as they affected this machine (the study was centered on a calender) and other machines, thereby providing for the most economical performance of the work.

A route chart was then prepared showing the particular processes and operations performed in the mill department. Analysis tickets were made out for each style of product (in this case rubber boots) to enable the planning clerk to collate the information for material requirements. It was found necessary to collect data which was in the head of the production superintendent and in notebooks of foremen in order to make these specification sheets complete.

After the survey of construction and material requirements was completed, it was found necessary to make a superficial job analysis without waiting to make a minute analytical study. Even this overall study brought about some prompt betterment of conditions:

1. Partial standardization of methods of operation.
2. Determination of proper sequence of running different stocks.
3. Standardization of material specifications and a classification of materials.
4. Introduction of piece work. This adjustment was not put into effect until machine control had been established for three weeks.
5. Location of an inspector at the conveyor belt to inspect and check stock while it was being run.
6. Suggestion and execution of a considerable number of mechanical changes, many of which were of prime importance in standardizing conditions and permitting even flow of work.
7. Preparation of a permanent instruction card which was posted at the machine.

The next step was the establishment of the mechanism for the follow-up and control of work on the machine. The plant was so large and the variety of products so great as to warrant a very complete development of control. In other plants, even similar in type, the scheme to adopt might be quite different. The information obtained in the analysis was transferred to route cards from which were typed the necessary tickets, such as time tickets, instruction, planning board, shop board, etc. In the meantime, planning boards, "ticker" boards in the mill, and pneumatic tubes were installed. The tickets were arranged by the order-of-work clerk on the planning board and on the ticker board, so that the workman always knew the job ahead of him. It was necessary all this time to carry on educational work among the men concerning the benefits which they would secure from the new system.

An analysis of the results showed that if the entire period from January 1 to September 30 had been under control to the extent shown by figures gathered in

[1] Process invention of W. Burton Wescott of The Thompson and Lichtner Co.

September for comparison with those of January, the gain would have been 102 miles, or enough boot top stock to manufacture 181,125 pairs of boots. The amount actually turned out up to September 30, would have been finished July 30 under controlled operation. A reduction of 85 per cent in idle machine time was shown on the same basis. The earnings of a group of 8 men showed an increase of nearly 18 per cent, or 8½ cents an hour each. The reduction in unit cost was 28.1 per cent, or approximately $3000 a year on this one machine. The total saving on calenders was

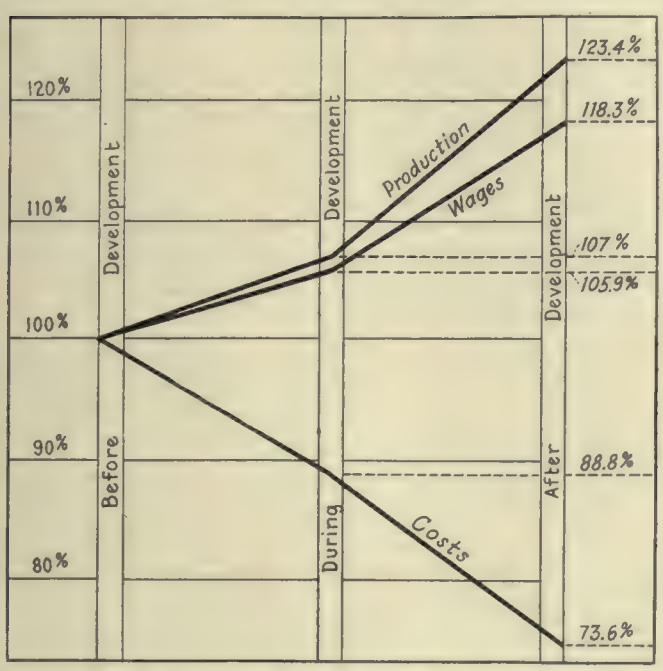


FIG. 1 RESULTS FROM PRODUCTION CONTROL ON SEVEN CALENDERS

$21,000 a year, and on breaking down and mixing mills $9000 a year, a total saving of $30,000 a year in the mill room.

In the mill room of another plant, where the calenders were running on stock without the many variations of the mill just described, it was found possible to gain control with a "running list" for the key operation—the calender—which gave the sequence of lots and also gave in advance the times at which each lot would be started.

Examples of Scientific Methods

In a mill mixing a compound for a material used for automobile tops, the time of mixing a batch was 30 minutes. By standardizing the operation, determining the best process of mixing and best time for each part of the work, arranging delivery of materials more conveniently, and introducing incentives, the time was reduced to 10 minutes per batch.

In another phase of the process involving boiling in alkali, the time of a cycle, from start to finish, was reduced over 25 per cent. This was done by giving the men an extra high incentive for three or four hours of exceptionally strenuous work and no incentive for the remainder of the day. This incentive was given only when they made standard time. As the operation was one requiring exercise of individual initiative, the men themselves could help greatly in doing work to best advantage. In this department there had been great difficulty in holding men, but with standardization and an incentive the labor turnover ceased to be a problem. The number of men was reduced from 15 to 9, with increased output.

Indicative of other savings made in a plant, which employed some 750 men before this development and some 550 afterward, the number of men on mill mixing was reduced from 18 to 11, one man was eliminated on cutting and bagging, three men on screen room trucking, three men on mill room trucking, 10 men on chopping, and four men on charging, bringing about a saving of approximately $40,000 a year.

The mill room in a small plant was the limiting department in the production of the plant and was turning out a product not quite up to standard quality. The work was on a bonus basis, but a bonus fixed like ordinary piece rates by the too common method of overall studies and records of past performance, instead of by detailed job analysis and time study. The work of installing new methods was continued over a considerable period of time with these results: An intimate study of the conditions, using a stop-watch and unit-time analysis, made it possible to re-group the workmen, eliminate unnecessary travel, keep the rolls in more continuous operation, and maintain improved quality. Step standards, a most effective type of incentive, were introduced. In this department employing some 150 men, a saving was effected under normal production of $60,000 a year in direct labor alone. Furthermore, the increase in production, effected without increase in the number of machines, increased the capacity of the entire plant 25 per cent, thus insuring indirect savings largely in excess of the direct savings. This decrease in cost was accompanied by an increase crease in earnings of the workmen of about 25 per cent.

An interesting feature of this development was the attack on the maintenance of quality. With men paid a bonus for production only, it is their natural tendency to disregard quality. To offset this, the incentive of the man who gaged the heat of the rolls on each line, and, therefore, was largely responsible for quality, was made dependent in part on production and in part on maintaining definite quality standards. If he failed in quality, he also lost his quantity bonus. After this had happened once, he made it his object to deliver a product that was just right to pass the requirements at the maximum permissible speed of production. Customers' criticisms were changed to commendations.

In another case, analysis of an entirely different type formed an interesting problem. A certain group of new machines had been tried out, but were about to be thrown into the discard. A thorough study of the operations, with changes in detail only, so increased the output and quality that a saving of $100,000 a year was made.

While the large savings are naturally of the greatest importance to management, there are innumerable small but worth-while savings to be made almost everywhere. Frequently the intangible results, hard to com-

pute on a dollars-and-cents basis, are of real worth in assuring continuous flow of work and prevention of delays. It is well worth while to make a job analysis which makes a 50 per cent cut in working force, even though the point of attack may be a group of only two men. An example of this type of work is found in the following case.

In one process finely cut rubber comes up on a belt and falls into a large oblong bucket, suspended from an overhead track. The material had to be run into the bucket properly, levelled off and weighed, its weight had to be recorded, and the bucket pushed some 100 ft. to a position over the piles and dumped. The two men appeared to be busy most of the time. A thorough study was made by a skilled analyst and these results obtained:

1. The bucket was adjusted to eliminate most of the levelling-off process.
2. The gate feeding material to bucket from belt was arranged to shut quickly and hold back material.
3. The trolley rail was levelled so that the bucket would push easily when full.
4. Instead—and here the greatest time saving was effected—of weighing each load, entering each weight on a sheet, deducting the tare, compiling the totals, and figuring the quantity for the final load to make the lot come out right, the operation was changed. Each bucket was loaded to a standard weight, varying only with different materials. In this way, all the operator had to do was to enter on his sheet the number of buckets, thus eliminating virtually all the clerical work.

The estimate of a 50 per cent reduction in working force may be slightly erroneous because the man left on the job was a one-armed man.

Savings on Canvas and Rubber Shoes

A study was made of a mill making canvas and rubber footwear and showed these savings: It was found that stock was ordered by the making department and the method pursued necessarily caused numerous interruptions on the machines in the mill room, roughly a 25 per cent excess of material, an exceedingly large waste, a poor flow of material, with resultant low production and increased costs. The study made possible a gain of about $12,000 a year in direct labor costs and reduction of idle machine time, and a decrease in the large intangible losses due to uncontrolled production.

A study of this kind to bring about standardization of methods and quality involves many complex factors. For example, on a grinding machine for breaking down gum, the size, surface speed, and temperature of the rolls are important elements. In cutting canvas, the study involved the comparative merits of clicking machines and beam presses, and the substitution of female in place of male operators. Besides the savings by wage adjustments, the saving of scrap was of great importance. The gains in direct labor costs were shown to be about $7000 a year.

A similar gain of $7000 a year was shown by the replacement of male labor by female labor in packing. In the making room it was shown that the ultimate gain in direct labor would be the reduction of about 36 per cent of the working force. This is only a partial picture of the savings possible when thorough analysis and standardization are applied to the operations common in the rubber industry.

Provide Employee Recreational Facilities

THE belief that contented workers are a very important factor in the success of any business enterprise is generally accepted by industrial executives. The conditions that are considered necessary to produce this state of mind in the workers are numerous and vary widely in different concerns.

Some companies believe that to pay fair wages is all that is necessary, while other companies hold the opinion that, while fair wages are always necessary, there are many other things the employer can and should do for his employees.

FIG. 1 TENNIS COURT ON ROOF OF WILLIAM T. HUGHSON COMPANY'S BUILDING

The William L. Hughson Company belongs to the latter class. They have invested considerable money in improving the plant, so that working conditions may be pleasant, and in providing supplementary features that may add to the employees' joy of being alive.

Every employee is provided with a private steel locker where he may keep safe such clothes or personal belongings as he desires to have at the plant. Large, pleasant, and well-lighted wash-rooms and showers are available to all. There is an up-to-date miniature hospital equipped with all necessary facilities for first aid. Parking space is provided on the roof of the building reached by ramps from the ground.

On the roof is located also a large glassed-in room, called the "democracy room," where employee meetings can be held. A well-equipped gymnasium is provided. On the roof are two hand-ball courts and a tennis court, a view of the latter being given in the accompanying illustration.

Wage Scales With a Reason

A Scientific Plan to Determine Relative Worth of Shop Occupations

By MERRILL R. LOTT

Personnel Superintendent, The Sperry Gyroscope Company, and Member Manufacturers' Council of the Brooklyn Chamber of Commerce

HERE is a problem for management, a persistent problem which often leads to serious difficulty. An industry employing men of many different trades has been operating for years with a balanced wage condition between the different occupations. The condition of balance has been reached naturally—by the free play of the "law of supply and demand" which has yielded a "prevailing rate" for each occupation. Then one fine day a group of workers comes forth with the statement: "We want more money. We are just as valuable to the company as the members of any other trade, yet our occupation gets less money than many others."

How has management met such a situation? It has usually said: "No, the business can't afford it," or perhaps after some hesitation, "Yes, it is the expedient thing to do to keep our people satisfied."

But is either of these replies really satisfactory? Neither one answers the implied question raised by the workers—"What is the value of our services in comparison with those rendered by men in other trades?" As time goes on, workmen will be less and less satisfied with short answers. They will ask "Why?" more frequently, and will expect replies based upon reason. With reason comes justice, and with justice more completely realized there will come in full measure the industrial harmony which is so essential to the well-being of all mankind. So it will be that employers of labor will more accurately establish and apply their wage scales in accordance with merit. In reality, it is a simple matter to do this.

It is generally understood that industrial products which are sold must pay for their cost of manufacture and yield a return to the men who have invested their money in the enterprise. Now, the cost of production must be low enough to permit the sale of the manufactured goods under competitive conditions, and the various elements that make up its total must be consistent one with another. Investigation reveals a rather definite relationship between pay-roll, materials, and that other group of items incidental to the operation of a business, such as taxes, interest, depreciation.

The pay-roll item is commonly the largest. With this definite sum of money available from the sales of product, the question arises: How is it to be apportioned among the people performing the various operations which make the existence of the business possible?

In a general way, the law of supply and demand has sifted these various qualities and provided rates of pay which have been accepted by both employers and employees. These may vary in amounts in different localities, but the relationship between occupations in one place is quite similar to those existing elsewhere. This may take care of the average condition, but what happens when special circumstances arise? What steps are to be taken when the average condition no longer prevails? It may be that changes in operating methods split up a given line of work into several branches for which new rates of pay must be established, or that the peculiarities of a given business develop an occupation which has no precedent. What then would be a fair wage rate? Or it may be, as in the problem stated, that a certain group may wish to lift itself bodily out of its position of balance with other lines of work.

The only safe and fair way to meet these situations is through a careful analysis of all the factors that influence the value of occupations. The factors applicable to one industry may vary slightly from those which prevail in another type of business, but for an executive of experience, their selection is simple and easy. The arguments presented "pro and con" in

> IT is refreshing to find employers wishing not only to do exact justice to those who work with them, but seeking to base their just acts on thorough knowledge of the factors entering into employment. If to this is added the human and sympathetic outlook which leads employers to put all the facts before the workers, asking that they themselves consider every factor of the problem from their own viewpoint independently—I say, if this wise and just procedure is added to the spirit and purpose first mentioned, then we have gone a long way toward both a human and a scientific settlement of industrial wage problems. I am glad, therefore, thus to associate myself with the statements which follow, because in their spirit and method they seem such as should be endorsed by thoughtful men. It is, of course, not assumed that in every detail they will be equally applicable everywhere, but it seems reasonably certain that there are few places in which they will not be suggestive and that, wherever they are known, the spirit of clear executive purpose united to human sympathy, and both clarified by scientific precision, will be inspiring.
>
> (Signed) WILLLIAM C. REDFIELD,
> *Director of the Brooklyn Chamber of Commerce, and Secretary of Commerce, 1913-1919.*

any wage controversy, the general observations of work conditions and requirements, all supply the factors for consideration.

The various factors to be considered differ from one another in their importance. These differences can be visualized by assigning weights to each one. The next procedure is to determine the extent to which each factor enters into the various occupations considered, and then by multiplication and addition determine an index figure for each line of work. These index figures, by the order of their magnitude, give the relative values of the occupations to which they apply.

These index figures may be readily translated into wage scales. Theoretically the minimum wage should be based upon that amount of money required to support the average family decently and comfortably, but as this "living wage" is more or less intangible, it is more practical to proceed on the following basis: Select an unskilled and a highly skilled occupation from the group of occupations considered. These should be well-recognized types of work, whose standings are generally accepted both from the standpoint of skill and wage rates. Then by using the index figures and wage rates that apply to these two selected occupations, it is an easy matter to construct a graphic chart or diagram from which equitable wage rates for other occupations can be directly read when once their index figures are known.

While the method described may be most readily applied to a single industry, it is conceivable that it might also be used to even out discrepancies that now exist between types of industries. In such a case the list of factors would be increased to include all that have a bearing upon the value of the lines of work considered, even though some may not be common to all.

In the comparison of types of industry or of occupations within an industry, it must be remembered that it is the yearly earnings that count and that differences in working hours and continuity of employment must be recognized by computing these on a common unit basis for wage payment. Wage payments based upon a given rate per hour, per week, per month, or per year as well as upon piece-work or premium plans with a guaranteed day's earnings—all may benefit by the application of the foregoing principles. This fact can be appreciated when consideration is given to the generally accepted practice that earnings should differ in accordance with the merits of each type of work, whether it be on "base rates" or "day's earnings."

Practical Application of the Plan

When the preceding outline is first considered, it is only natural that the question should arise as to its practical value. A person might justly say, "That all sounds very well but will it work?—How can it be applied?" This can best be answered by giving an actual illustration which concerns the satisfactory settlement in a case of the very problem suggested at the beginning of this article. Before going through the details, it may be well to state that the answer was arrived at through independent analyses by a group of executives and by a group of employees. These separate investigations yielded exactly the same results; therefore, the joint conclusion was acceptable to all.

In a manufacturing plant producing a very high grade of instruments, the machine shop occupations included those of engine lathe operator and bench lathe operator. In many respects, these two occupations are similar, for they both involve the operations of turning, boring, drilling, and, in some instances, screw cutting as well as a few other machine processes. Yet the character of the general run of the work and the method of approach are different. The bench

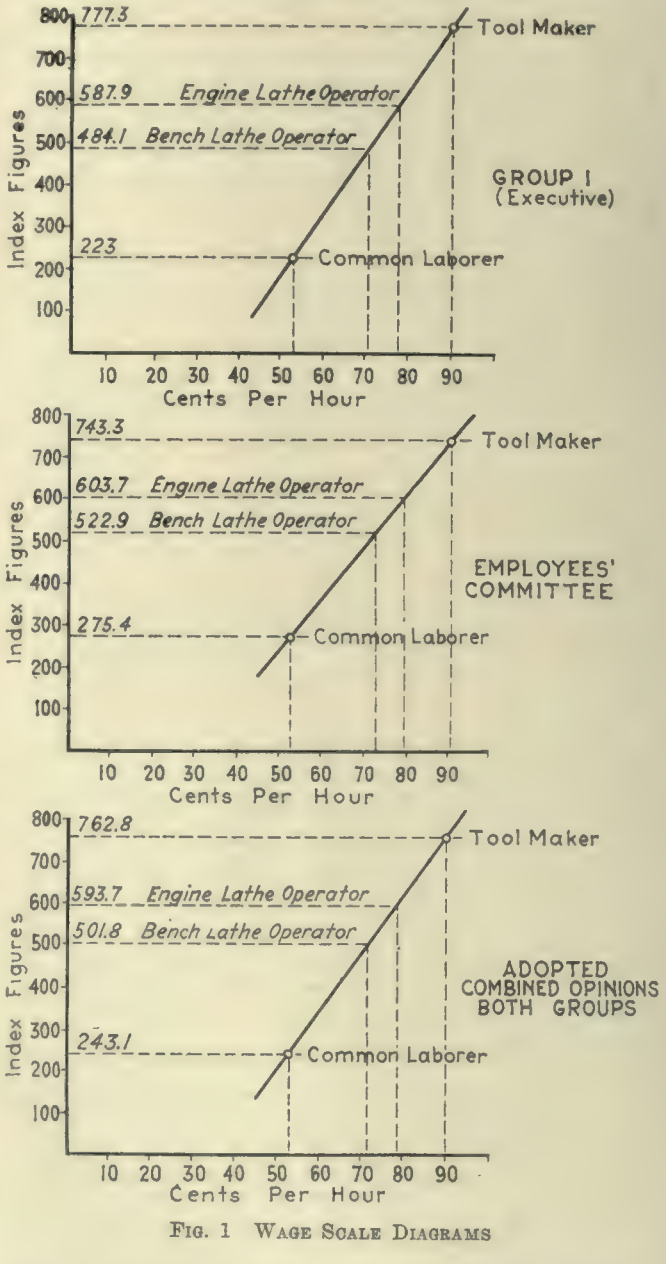


FIG. 1 WAGE SCALE DIAGRAMS

lathe is adapted to small work and the engine lathe to larger and heavier pieces. The nature of the company's product required a high degree of precision for parts coming from both types of machine tools.

The rate of pay for the bench lathe operators was $0.73 per hour and that for the engine lathe operators was $0.80. These rates had resulted from years of

TABLE 1. RELATIVE VALUE OF FACTORS INFLUENCING THE WORTH OF AN OCCUPATION

A comparison of opinions

No.	Factor	Weights Assigned By		
		Group 1	Committee	Combined
1	Time usually required to become highly skilled in occupation	21.7	18.6	20.4
2	Time usually required for a skilled man to adapt himself to work	6.4	5.3	6.0
3	Scarcity of labor supply	4.9	5.1	5.0
4	Difficulty for an employee to secure similar work elsewhere	4.4	5.6	4.8
5	Educational requirements	10.6	10.2	10.4
6	Prevailing rate of pay	4.1	4.2	4.1
7	Degree of skill and accuracy required	10.0	10.7	10.3
8	Necessity of constantly facing new problems—intelligence	9.0	5.9	7.8
9	Cost of errors—unintentional, spoiled work, etc.	6.2	6.7	6.4
10	Dependence that must be placed upon employee's integrity	7.4	7.9	7.6
11	Dirtiness of working conditions	3.2	3.7	3.4
12	Exposure to health hazards	3.1	3.7	3.3
13	Exposure to accident hazards	3.4	3.9	3.7
14	Physical effort required	3.1	4.3	3.6
15	Monotony of work	2.5	4.2	3.2
	Total	100.0	100.0	100.0

operation which had established a balanced condition of wage scales for all of the machine shop trades, and all of these compared favorably with the "prevailing rates" in the district. Then one day the bench lathe operators requested that their wage scale be brought up to that of the engine lathe operators, stating that their skill and work were just as valuable.

As far as the amount of money involved was concerned, the increase could have been granted without seriously affecting the company's financial standing, but the general relationships with other occupations would have been destroyed, and there was no means of knowing how far-reaching the resulting disturbance would be. It was, therefore, important to base a decision upon a firm foundation. If there was justification for an increase, the bench lathe operators should receive it; if no change was warranted, then there should be a clear reason for refusal to grant the request. An analysis of the existing situation was undertaken along the lines which have been previously outlined.

The factors influencing the value of occupations in the manufacturing establishment were selected from the arguments advanced by the bench lathe operators and from general observation of working conditions. These 15 factors were:

1. *Time usually required for a man to become highly skilled in his occupation.* This item is an investment on the part of an individual and as such, should yield a return to the one who has made it.

2. *Time usually required for a man skilled in an occupation to adapt himself to the particular conditions that exist in the employing company.* Experience has shown that some lines of work require a greater period than others for men to fit into the requirements of a company and qualify as being "highly skilled" in its work, even though they may have been regarded as being highly skilled in the fundamentals of that line of work elsewhere.

3. *The scarcity of men following a trade in a given locality.* The scarcity of a given type of worker has usually exerted a very decided influence on the rate of pay. This factor is a recognition of the law of supply and demand.

4. *The difficulty which an employee would experience in securing similar work elsewhere which would yield similar earnings.* The employment of a "specialist" on a type of work peculiar to the company, places the worker in a more precarious position for earning a living than would be the case of a man employed in a line which is universal in its use. The "specialist," therefore, makes a sacrifice in his chances for earning a livelihood which should be recognized by the employer.

5. *Educational requirements—the equivalent of*

TABLE 2. EXTENT TO WHICH FACTORS LISTED IN TABLE 1 ENTER INTO VARIOUS OCCUPATIONS

Comparison of opinions given by executive group with those of committee.

Scale of 10 is applied, 10 points being allowed to occupation for which the factor assumes greatest importance.

Occupation	Time Required to Learn Trade (Factor 1)			Time Required to Adapt Skill to Work (2)			Scarcity of Labor Supply (3)			Difficulty in Locating Work Elsewhere (4)			Educational Requirements (5)			Prevailing Rate (6)			Degree of Skill and Accuracy (7)			Ingenuity (8)			Cost of Errors (9)			Honesty of Effort (10)			Dirtiness of Working Conditions (11)			Exposure to Health Hazard (12)			Exposure to Accident Hazards (13)			Physical Effort (14)			Monotony (15)			Index Figures
	Group 1	Committee	Combined	Group 1	Committee	Combined	Group 1	Committee	Combined	Group 1	Committee	Combined	Group 1	Committee	Combined	Group 1	Committee	Combined	Group 1	Committee	Combined	Group 1	Committee	Combined	Group 1	Committee	Combined	Group 1	Committee	Combined	Group 1	Committee	Combined	Group 1	Committee	Combined	Group 1	Committee	Combined	Group 1	Committee	Combined	Group 1	Committee	Combined	Combined Opinions
Assembler on simple work	1.6	2.0	1.7	1.9	2.1	2.0	....	....	2.0	1.6	1.4	1.5	2.0	3.6	2.5	....	....	3.0	2.8	3.0	2.9	2.2	3.0	2.5	2.7	2.5	2.6	2.8	3.1	2.9	1.6	2.3	1.9	1.2	1.7	1.4	1.6	1.4	1.5	1.4	1.8	1.6	5.6	5.0	5.4	229.9
Buffer and polisher	3.6	3.3	3.5	2.2	2.1	2.2	....	....	8.0	2.4	2.1	2.3	2.4	3.3	2.8	....	....	7.0	2.8	4.4	3.5	3.1	4.7	3.8	2.9	3.9	3.3	4.3	5.0	4.6	9.8	9.9	9.8	9.4	10.0	9.7	8.6	7.7	8.2	8.0	8.6	8.2	6.5	6.1	6.3	460.0
Inspector—tool	8.7	8.3	8.5	4.9	4.3	4.7	....	....	8.0	5.6	2.9	4.5	9.8	9.6	9.7	....	....	10.0	10.0	9.6	9.8	8.6	9.4	8.9	9.3	9.9	9.5	9.6	9.9	9.7	1.7	3.1	2.3	1.3	1.9	1.5	1.4	1.7	1.5	2.6	3.4	2.9	2.6	2.4	2.5	746.8
Inspector—subassemblies	6.0	7.6	6.6	8.1	7.0	7.7	....	....	10.0	6.8	5.4	6.2	6.8	8.4	7.5	....	....	8.0	7.5	8.3	7.8	6.4	7.7	6.9	7.2	8.3	7.7	8.6	8.0	8.4	1.5	3.0	2.1	1.1	2.0	1.5	1.1	1.6	1.3	2.5	2.6	2.6	2.9	3.7	3.2	665.0
Inspector—process parts	4.6	4.4	4.5	3.4	3.3	3.4	....	....	5.0	4.5	3.3	4.0	6.4	6.4	6.4	....	....	7.0	7.0	6.6	6.8	5.7	5.4	5.6	7.0	6.4	6.8	7.5	6.4	7.1	1.9	2.9	2.3	1.2	1.7	1.4	1.2	1.3	1.2	2.4	2.1	2.3	3.8	4.3	4.0	500.5
Inspector—junior grade	1.8	1.4	1.6	1.9	1.1	1.6	....	....	3.0	2.1	2.1	2.1	3.5	3.3	3.4	....	....	4.0	3.7	4.0	3.8	3.0	3.1	3.1	2.9	2.4	2.7	5.7	4.6	5.2	1.5	1.9	1.6	1.2	1.4	1.3	1.1	1.3	1.2	1.9	1.4	1.7	4.1	5.7	4.8	274.7
Laborer—common	1.0	1.0	1.0	1.1	1.0	1.0	....	....	1.0	0.9	1.0	0.9	0.7	1.1	0.9	....	....	1.0	0.9	1.0	0.9	1.1	1.0	1.1	1.3	1.0	1.1	3.3	2.7	3.0	8.7	8.7	8.7	7.3	9.3	8.3	8.6	8.6	8.6	10.0	10.0	10.0	4.7	8.2	6.5	243.1
Mach'e oper'r—bench lathe	3.9	4.1	4.0	4.2	2.1	3.4	....	....	5.0	3.9	3.7	3.8	5.6	6.6	6.0	....	....	4.0	8.2	7.9	8.1	6.6	7.9	7.1	5.5	6.7	6.0	3.9	6.7	5.1	3.0	3.7	3.3	2.0	3.4	2.6	4.4	3.1	3.9	2.7	4.0	3.2	4.6	4.9	4.7	501.8
Mach'e oper'r—engine lathe	6.2	5.6	5.9	4.0	2.1	3.2	....	....	5.0	3.5	1.7	2.8	6.7	7.4	7.0	....	....	6.0	7.9	8.7	8.2	7.3	8.6	7.8	6.9	8.6	7.6	4.5	6.9	5.5	5.4	6.8	6.0	2.3	2.9	2.5	5.9	5.9	5.9	5.1	5.9	5.5	4.3	3.1	3.8	593.7
Machine operator—milling machine	6.4	5.6	6.1	4.3	2.1	3.4	....	....	6.0	3.4	2.1	2.9	6.9	8.1	7.4	....	....	5.0	8.0	8.9	8.4	7.7	8.6	8.1	6.8	8.6	7.5	4.6	6.9	5.5	5.3	6.8	6.0	2.3	2.9	2.5	5.8	6.1	5.9	4.8	6.0	5.3	4.3	3.1	3.8	607.3
Tool maker	9.9	8.9	9.5	3.0	2.1	2.6	....	....	5.0	2.8	2.4	2.7	9.6	9.7	9.7	....	....	10.0	10.0	9.9	9.9	9.5	10.0	9.7	9.0	9.8	9.4	8.4	9.0	8.7	4.2	6.1	5.0	2.6	2.4	2.5	5.5	5.3	5.4	5.0	5.3	5.1	1.9	2.4	2.1	762.8

grammar school, trade school, high school, etc. Education is another investment factor which may form a part of the workman's capital. Schooling may not have been acquired in the classroom. Many people have secured the equivalent through efforts on their own part under less favored circumstances.

6. *Prevailing rate of pay in vicinity.* The "prevailing rate" of pay for a given line of work has usually been an important factor in the preparation of wage scales for a given company. This is an item which recognizes the law of supply and demand.

7. *Degree of skill and accuracy required.* The degree of skill, manual dexterity, and accuracy required constitute some of the refinements that distinguish skilled work from that of an ordinary nature. It is generally accepted as being reasonable that refinement of work should affect its cost and be reflected in its value.

8. *Necessity of constantly facing new problems.* The capacity of an individual worker to meet old problems in new shapes is a mark indicating a higher order of intelligence. Certain pieces of work may require a high degree of accuracy, but their constant repetition makes the matter of skill largely one of habit. Frequent changes in shape or kind of work, however, may require much ingenuity on the part of the worker—it requires a higher order of intelligence.

9. *Money value of parts worked upon and equipment used—possible loss to company through errors.* The responsibility placed upon an individual to guard against financial loss to the company, due to error in the line of duty, forms one of the demands for carefulness upon the part of the worker which may be of great importance. This applies to the cost of errors which are unintentional but which form a "work hazard." For example: An inspector of tools may, through a mistake in checking his measurements, let a defective tool pass through his hands and out into the factory for manufacturing purposes. While the error may be caught when the defective tool is first used for manufacturing purposes when the first part is produced, and while this may stop the ensuing waste of materials, there is a delay experienced to production which may be serious and expensive.

Another example may be found in the case of a tool hardener who, through an error in his heat treatment process, may cause the work entrusted to him to become a total loss.

10. *Dependence that must be placed upon the integrity and honesty of effort of an employee.* The dependence that must be placed upon the integrity and honesty of effort of an employee is a demand upon his moral virtues. Some lines of work are not easy to check for quality of work or for the time consumed in its accomplishment, so such jobs leave much to the honesty of the individual.

11. *Dirtiness of working conditions.* The cleanliness of working conditions—the freedom from oil, dirt, and dust—make it easier for an employer to secure and retain help; and conversely the absence of desirable conditions may require the employer to offer some special inducement for men to engage in work which is inherently dirty.

12. *Exposure to health hazards.* Occupations that are not detrimental to health are more desirable than others. Those which involve health hazards call for recognition through the pay envelope according to the degree of exposure which they exert.

13. *Exposure to accident hazards.* Lines of work differ in their inherent hazards to life and limb—the ones which are most dangerous deserve some offsetting compensation.

14. *Physical effort required.* The desirability of following a given line of work will be largely influenced by the degree to which physical effort enters into it. The element of fatigue must be paid for.

15. *Monotony of work.* The monotony of certain operations has been the subject of much discussion. So this item finds a fitting place in the consideration of factors entering into the worth of an occupation. The old saying "Variety is the spice of life" indicates the line of preference.

TABLE 3. METHOD OF CALCULATING INDEX FIGURES

Factor Number	Weight of Factor From Group 1, Table 1 A	Calculations Based Upon Points Given Under Group 1, Table 1							
		Toolmaker		Laborer—Common		Bench Lathe		Engine Lathe	
		Points Allowed B	A*×B	Points Allowed C	A*×C	Points Allowed D	A*×D	Points Allowed E	A*×E
1	21.7	9.9	215.0	1.0	21.7	3.9	84.7	6.2	134.3
2	6.4	3.0	19.2	1.1	7.0	4.2	26.9	4.0	26.4
3	4.9	5.0	24.5	1.0	4.9	5.0	24.5	5.0	24.5
4	4.4	2.8	12.3	0.9	4.0	3.9	17.2	3.5	15.4
5	10.6	9.6	101.5	0.7	7.4	5.6	59.3	6.7	71.0
6	4.1	10.0	41.0	1.0	4.1	4.0	16.4	6.0	24.6
7	10.0	10.0	100.0	0.9	9.0	8.2	82.0	7.9	79.0
8	9.0	9.5	85.5	1.1	9.9	6.6	59.4	7.3	65.7
9	6.2	9.0	55.8	1.3	8.1	5.5	34.1	6.9	42.8
10	7.4	8.4	62.1	3.3	24.4	3.9	28.9	4.5	33.3
11	3.2	4.2	13.4	8.7	27.9	3.0	9.6	5.4	17.2
12	3.1	2.6	8.1	7.3	22.6	2.0	6.2	2.3	7.1
13	3.4	5.5	18.6	8.6	29.2	4.4	15.0	5.9	20.0
14	3.1	5.0	15.5	10.0	31.0	2.7	8.4	5.1	15.8
15	2.5	1.9	4.8	4.7	11.8	4.6	11.5	4.3	10.8
Index Figure			777.3		223.0		484.1		587.9

* Slide-rule computation.

Weighting the Factors

As these preceding factors differ in their relative importance, they should be "weighted." This can be done by allowing 100 points as a total, and apportioning them among the 15 factors listed, so as to emphasize the proper relationship of one to another. This procedure is based upon opinion, and while the ideas of one fair-minded and experienced person may be satisfactory, it is desirable to check them against the opinions of other individuals who are qualified to express themselves intelligently on the subject.

Such a consensus of opinion was secured in the case being discussed, and is shown as the average of the ideas of a group of executives in the figures of Group 1,

Table 1. It was interesting to find, during the tabulation of the independent opinions secured, that there was a very close agreement between them for each point considered.

Having determined the factors and their relative importance, there remains the necessity for determining the extent to which each factor enters into the various occupations comprising the group being considered. This can readily be accomplished by working on a scale of 1 to 10 to distinguish the various degrees of importance. That is, all of the occupations are considered comparatively with one another for each factor. For the occupation which should receive the full allowance, 10 points would be allowed, while the occupations to which the factor did not apply as completely, would be given fewer points, according to their relative importance. If there was an occupation in which the factor had no significance, a zero would be given.

For example, when considering the factor dealing with the length of time required to become highly skilled in a trade, suppose there were no occupation on the list which would require much more than 10 years for a man to become a skilled worker. The following scale of values might apply:

Give 10 points to the occupation requiring 10 years or more
Give 9 points to the occupation requiring 9 to 10 years
Give 8 points to the occupation requiring 8 to 9 years
Etc.

A number of independent opinions should be utilized in the assignment of these points and the average taken to secure the consensus of opinion. In the case serving as the illustration, there was again great harmony between the opinions of different individuals on each point. The averages are shown under Group 1, Table 2.

The index figure for each occupation is determined by multiplying the weight of each factor by the points allowed when considering the extent to which the given factor applied to the occupation. The sum of these products gives the index figure. See Table 3 for an example of the process.

Constructing the Wage Scale Diagram

The determination of the index figures for the various occupations gives a definite measure of the relative values of the different lines of work. The numerical value of the index figure for each occupation indicates the consensus of opinion as to the relative value of that occupation. This will remain constant as long as the items entering into its computation remain unchanged. Wage scales may go up or down with the change in living costs, but index figures are usually not affected.

To convert the index figures into wage rates for the case in question, it was decided that tool making should be taken as a highly skilled occupation. The art, skill, and knowledge required to make the tools of precision and manufacturing aids to production has long been recognized as being one of the best and highest types of work in the plant. The common laborer was taken as a type of unskilled work. These two lines of work both enjoyed wage rates which were generally acceptable, so they served as basic points for determining the rate line of wage scale diagram.

The index figure, taken from Group 1, Table 3, for tool makers is 777.3, and for common laborers 223.0.

The existing wage rate for tool makers is $0.90, and for common laborers is $0.53 per hour.

Wage scale diagrams were then constructed (see Fig. 1) using index figures as ordinates and wage rates as abscissas. Two points were plotted and connected by a straight line.

Knowing the index figures for the different occupations, it is an easy matter to find the corresponding wage rate from the diagram. Thus from Group 1, Table 3, we find that the index figure for bench lathe operators is 484.1, and for engine lathe operators is 587.9. On the diagram of Fig. 1, these index figures correspond to $0.705 per hour and $0.775 per hour, respectively.

When compared with the existing rates of pay, $0.80 per hour and $0.73 per hour, it was evident that there was no justification for raising the rate of bench lathe operators to that of engine lathe operators.

An announcement of these findings could have been made to the employees at this point in the investigation, but it was believed that they might derive benefit from conducting an analysis of their own. With this in mind, a suggestion was made to the employees that they select a committee from their associates—men in whom they would have confidence and who would be competent to go deeply into the situation. This was readily accepted. The committee was not informed of the results of the analysis conducted by the group of executives, but was told the procedure. The members expressed their satisfaction with the fairness of the method and willingly carried out the analysis, independently from one another. Their findings are shown on the various tables under the heading of "Committee."

When the committee's index figures were compiled and the diagram plotted as shown, they yielded the same result as the analysis conducted by the executive group, for they showed a difference of 6.5 cents per hour between the rates which should apply to bench lathe operators and engine lathe operators, while the analysis by the exeeutive group showed a difference of 7.0 cents per hour. Therefore, when the opinions of all were averaged, there was general satisfaction in the resulting weights assigned the different factors and the points allowed for the various occupations as well as with the resulting index figures. The combined opinions are expressed in the columns so indicated in the accompanying tables. Fig. 1 shows also the wage scale diagram which was adopted by the employees' committee and the executive group, and which represented their combined opinions.

A basis was thus established for the adjustment of all wage scales. The analysis showed that some occupations were underpaid and provided a means for correcting the undesirable relationship. Though a few lines of work were found to be slightly overpaid, there was no revision made downward in those wage rates, but this fact will be considered in future general wage adjustments, at which time it is intended that all rates shall be brought into the proper relationship one to another.

Steel Shelving in Industry

STEEL shelving is rapidly replacing wood racks and bins in industrial use. It is strong, everlasting, fireproof, easily adjusted to any requirement, interchangeable, and wastes only a minimum of space. Moreover, it is usually cheaper in the end, under present costs of labor and lumber. Its cleanliness and general neatness, of course, place it far above wood in desirability from this standpoint.

FIG. 1 STEEL RACKS FOR STORING AUTOMOBILE SPRINGS

The J. E. French Company use steel shelving in a variety of ways, as illustrated in the accompanying photographs. Fig. 1 shows an automobile spring rack, consisting of uprights and narrow shelves. This arrangement gives the proper spread for storage. Complete assemblies are set crossways and grouped in 4 tiers, separated into front and rear, and right and left. Individual leaves are stored on the shallow shelves.

To the right in this photograph is shown the carrying out of the tray idea on shelves rather than the use of bins or pigeon-holes for small parts. For this purpose a type of partition is used which is low in front and slopes upward toward the back. Complete visibility and plenty of hand room are thus provided. These advantages are highly appreciated by storeskeepers and the handling time and cost are materially reduced.

FIG. 2 FENDER STORAGE

In the fender rack, Fig. 2, the proper spread is obtained by the use of narrow shelves set on uprights. The fenders are carried in 5 tiers and are classified into lefts and rights. They are thus easy to stock and remove, and when handled and while in storage they are in no danger of being scratched or dented.

Wheels, rims, and tires are stored vertically on shelves which slope from both sides toward the middle. Increased accessibility, economy of space, uniformity of appearance and prevention against the stock rolling off the shelves are brought about by this plan.

Fig. 3 shows how a wide variety of large and small parts is carried in one section, due to the adjustability of the shelving and the use of different sizes of partitions. In the top are fuel tanks, below these are smaller parts, and in the bottom are fenders, doors, etc. With little work a complete change in arrangement can be made in sections like this, in case the location of parts is to be shifted, or expansion of stock makes some alteration necessary.

FIG. 3 LARGE AND SMALL PARTS IN THE SAME SECTION

Further economy of space is accomplished by equipping the ends of the steel racks with metal hooks, on which crankshafts, camshafts and other long, narrow parts are carried. Beside utilizing an otherwise waste space to advantage, this scheme places within convenient reach stores which are hard to get in and out under any different method of stocking.

$612,955 Saved by Waste Reclamation

Southern Pacific Shops Recover This Amount in One Year

By A. S. KELLIGON

General Storekeeper, Pacific System, Southern Pacific Railroad

BY various methods of accumulation, and reclamation or sale of discarded material, a total saving of $2,531,878.72 was made during 1923 on the Pacific System of the Southern Pacific Railroad. Out of the vast accumulation of scrap gathered in by supply trains from all points on the system, $612,955.32 of the above sum was saved by the shops through reclamation work.

The statement for 1923 follows:[1]

SAVING BY RECLAMATION

Value of reclaimed materials if purchased new		$970,139.18
Scrap value	$17,758.55	
Reclamation cost	339,425.31	
Total cost		357,183.86
Total savings effected		$612,955.32

SCRAP ACCUMULATION

Scrap sold, 51,665 tons for	$665,584.12
Scrap used in industries, 58,245 tons value	1,253,339.28
	$2,531,878.72

This statement is exclusive of savings effected by conservation and other economies, such as manufacturing of useful articles from worn out or discarded materials. No record is kept of such savings. Moreover, it does not include the money saved by reconditioning parts which are sent in for the purpose of being repaired and returned to service—air brakes, parts such as triple valves, pumps, air-brake hose, and a wide variety of other equipment.

The supply trains each month sweep the roadway clean, and material found is brought in to the central scrap docks at Los Angeles, West Oakland, Sacramento and Portland. At these points there are special scrap sorting tables, rigged up to avoid the necessity for men to stoop over when doing the work. The planks of the table are loose and are removed as fast as the scrap is worked out, bringing the sorters up to the material all the time. (See Fig. 1.)

[1] The savings brought about by reclamation on the Pacific System of the Southern Pacific Railroad during 1921 are:

Value of reclaimed material if purchased new	$1,309,288.08
Reclamation cost	437,011.15
Total savings effected	$872,276.93

This latter amount includes the scrap value of the reclaimed material, which, if deducted, would reduce the total savings, although not by a large sum.

Everything that has been discarded has its usefulness. The men working at the scrap docks have been with the company for a long time, and are experts in knowing the nature of each article they find, whether it is of malleable or cast iron, rolled or forged steel, etc. The material which must be sold as scrap, of course, brings a higher price when sorted.

The foremen and employees in charge of this work

FIG. 1 ONE OF THE SCRAP SORTING TABLES

are continually striving for new and better methods of handling it and of adding to the great savings which have already been brought about. They have a well-merited pride and satisfaction in making "two blades of grass grow where one grew before."

In order to reclaim various materials and articles cheaply and quickly, engineers of the company have devised special machinery for the purpose, frequently using old machinery, itself salvaged, which has been remodeled to meet special requirements. In every case possible, the reclamation machines are operated by compressed air.

J. W. Horridge, foreman in the Los Angeles shop, devised a compressed-air-operated machine to strip scrapped dry cells. The zinc and brass removed are sold for scrap and the wax is made into sealing wax. While the saving in this instance is not large, it more

FIG. 2 COMPRESSED-AIR-OPERATED MACHINE FOR CLOSING IN VALVES

than pays for labor and other costs, and disposes of one item that otherwise would be rubbish. This machine has a plunger operated by an air piston placed at the top of the apparatus.

One of the activities consists of shrinking valves by compressing machine, when the threads are so badly worn as to cause loose joints which leak. The proper size plug is screwed in each valve and the latter is then placed in a special shop-made machine that shrinks the connection to the correct dimensions. (See Fig. 2.) Shop-made machines are also used for the turning down of seats and grinding valve stems. (See Fig. 3.) Valves and bolts that have been reclaimed are shown in Fig. 4.

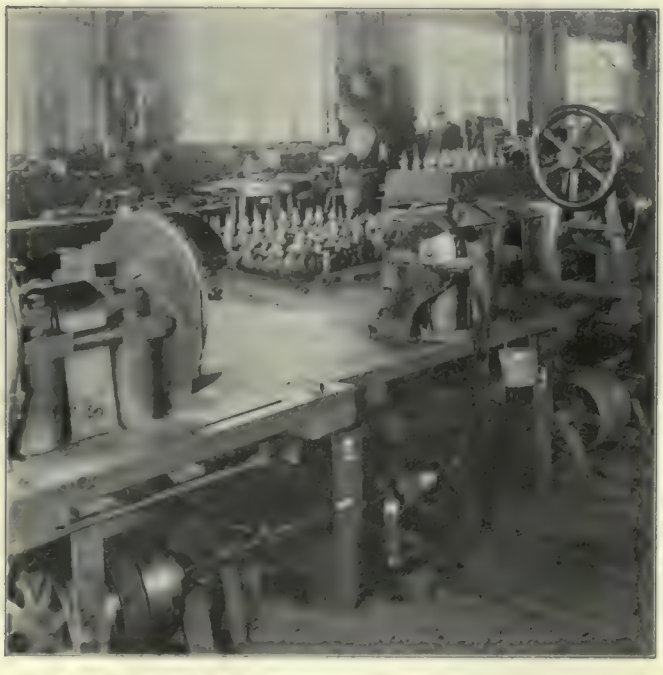


FIG. 3 MACHINE FOR REGRINDING AND RETHREADING VALVES

Track spikes in need of straightening are handled through an oil furnace by gravity. While hot, the spikes are dropped into a home-made spike-straightening press operated by compressed air. If the heads are out of alignment, they are given a light blow with the air hammer. The press is double-acting so that the instant the finished spike is released the center block starts compressing the spike just dropped into place on the opposite side. thereby saving air and increasing production. This machine straightens 2000 spikes in an 8-hr. day, at half the cost of new spikes. It is shown in Fig. 5.

In the Los Angeles reclamation shop there is a machine used for straightening bolts. This machine, which reclaims all bent bolts and rods of the larger sizes, was salvaged from a scrap wheel press, being converted into a motor-driven machine with the necessary dies.

There is no market in this territory for scrap wire-inserted hose, so by removing the wire insertion by use of a shop-made machine the wire and hose are separated into salable scrap. (See Fig. 6.)

Klinger-type water glasses, when so badly worn down as to permit leakage, have heretofore been considered scrap. They are now reclaimed by placing the glasses in the holders of motor-driven, shop-made grinding ma-

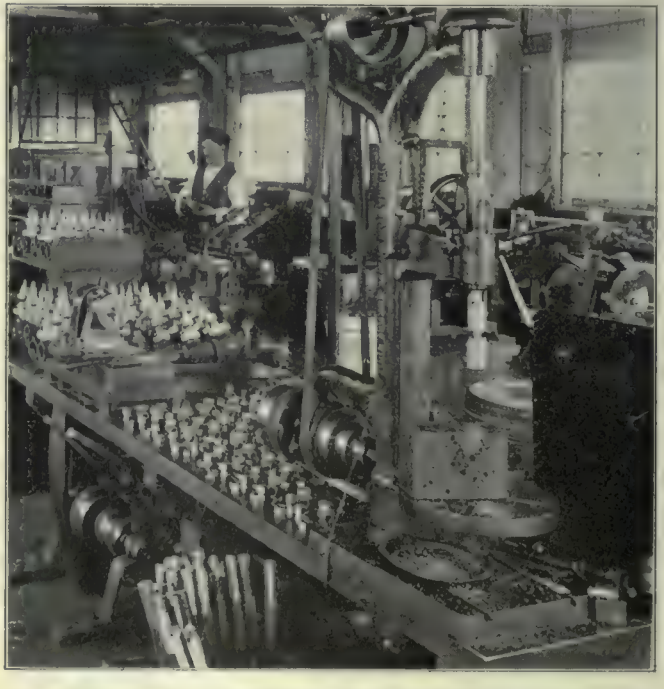


FIG. 4 VALVES WHICH HAVE BEEN RECLAIMED

chines, with oscillating movement. Six glasses are ground at one operation.

At the Los Angeles reclamation plant there is a rattler for reclaimed fittings, made of perforated scrap boiler plate and operated by motor. Fittings of all kinds are placed in the rattler and submerged in a vat of wiping oil, or distillate, and rotated. This process removes rust and all foreign substances and the finished articles look like new.

Strainer boxes used between locomotive and tender, which have been discarded on account of worn or bat-

tered threads, are again made serviceable by removing the old threads by machine, building up the metal by the oxy-acetylene welding process, and rethreading. The result is strainer boxes as good as new for 35 per cent of their original cost.

Couplers, condemned on account of worn shanks, are again returned to service by removing the worn part of the shank by the use of a cutting torch and welding a piece of scrap boiler plate of proper size in place. The resulting saving averages 22 per cent

FIG. 5 MACHINE FOR STRAIGHTENING TRACK SPIKES

of the cost of new parts. When repaired, each coupler is stamped with the initials of the mechanic doing the work, and the date and shop. Of 6277 couplers repaired in this manner, only 3 were returned or reported as failures.

Scrap tires are reduced to charging box size by the cutting torch. The billets made from them are heated and hammered out under a steam hammer and by the use of swage tools are made into heel and toe ends of claw bars. Tire steel is also used in the manufacture of lining bars, repointing of track picks, and for various other purposes.

Superheater units are reclaimed by renewing the return bends or applying new ball joints. The bends are formed out of scrap and are welded to the end of the unit, making one continuous pipe. The ball joints are turned out of bar stock. A projecting lip engages the end of the unit pipe, holding the work central during the autogenous welding process. The unit joint is finally polished with a carborundum cloth, held in a cup-shaped chuck attached to an air motor. Gages are used on all points and seats to insure proper contour.

Scrap boiler tubes are used for a number of purposes. When threaded or butt-welded together they are

FIG. 6 SCRAP RUBBER FROM AIR HOSE

used for water drain lines (after dipping in hot asphaltum), for air lines, conduits, etc., for manufacturing of locomotive pilots, in making freight car ladders, and in making washers by flattening out and punching, two washers being made in one operation.

Scrapped coil springs are heated in a furnace, pulled out straight by an air machine, straightened under a steam hammer and made into buggy, jack and pinch bars.

Shovels with broken handles are re-handled, and broken shovel blades are welded by the oxy-acetylene process. Cost of the latter repairs is 54 per cent of the cost of new. Shovels with broken handles and worn blades are made over into stove shovels.

At the reclamation plant in Sacramento there are

FIG. 7 GAS SUPPLY OUTLET FOR CUTTING AND WELDING

9 cutting torch outlets. (See Fig. 7.) Acetylene gas is made in a central plant recently erected, and piped to all parts of the yard. This method does away with portable generators or carting gas tanks to the job. The oxygen is also distributed through pipe lines from manifolds. A man doing cutting, or welding, has only to couple his torch onto the most convenient outlet.

These outlets are protected by four steel rails in the form of a pyramid as shown to the left in Fig. 7. When the operator is using a torch at some distance from the outlet, the hose is carried overhead on metal poles, as shown, so that it is never in the way.

In the acetylene generating house, five 300-lb. generators have been installed. The oxygen is purchased in steel tanks, into which it has been compressed to a pressure of about 2000 lb. per sq. in. These tanks are attached to the manifolds and the pressure is reduced to 75 lb. per sq. in. for delivery into the pipe lines. On the acetylene line the pressure is 15 lb. per sq. in.

In many instances material discarded by one department is used for another, and thereby large savings are effected. A few examples of methods used to bring about such savings are cited here.

Oil storage tanks are made from old boilers. Fire-boxes, heads and flues are removed, leaving only the shell. This shell is cut to the size required, and tank steel plates are welded to each end. All holes are welded shut. Thus the purchase of new oil tanks is unnecessary. The cost of this work averages $50 per tank. New tanks average $200 and hence there is a saving of $150 on each. The total net saving during 1923 in this work was $1747.20.

Old paint brushes are received from painting jobs by the conservation practice of giving out new tools in exchange for old. Brushes satisfactory for rough work are used for painting castings, track material, locomotive front ends, etc., and for cleaning and washing patterns and pattern frames. The handles of unusable brushes are saved and sold to manufacturers. A saving of $297 during 1923 resulted from this plan.

Old brooms, after serving their period of usefulness for other purposes, are used by the Steamer Division for scrubbing hulls of steamers, by the Maintenance of Way Department in whitewashing cattle guards and fences, and as snow brooms for switches.

Scrap carpet is used for making dust guards, covers for foot rests and hand protection pads.

Scrap cotton waste is thoroughly cleaned, carded and all foreign substances removed. It is then boiled in oil, packed in barrels and used in place of new.

Sediment from acetylene generators is used in place of lime for whitewashing purposes, and as a substitute for lime in the steel foundry.

Tarlene, a by-product of Pintsch gas plants, is used for painting underframes of cars.

A few of the many representative savings made in various materials are listed in Table 1.

TABLE 1. SAVINGS IN MATERIALS—PARTIAL LIST

CLASS	ARTICLE	DISPOSAL	METHOD OF EFFECTING DISPOSAL	ANNUAL SAVING 1923
Locomotive and Car Parts and Fittings	Boilers	Converted	Made into oil storage tanks.	$ 1,747.20
	Bolts	Reclaimed	Straightened and reused.	.....
	Brake beams	"	12,275 repaired.	16,104.27
	Brake shoes	"	15,850 repaired.	2,850.00
	Castings	"	720,000 lb. repaired.	45,000.00
	Fittings	"	Cleaned in rattler with oil.	.....
	Gage glasses	"	Reground and reused.	.....
	Couplers	"	3,055 by acetylene welding blowpipe at 22 per cent cost of new.	35,758.15
	Coupler knuckles	"	7,100 repaired.	25,930.00
	Hose—air and water	"	Defective parts cut off and fittings reinserted.	732.61
	Hose, wire-inserted	Scrapped	Separated by machine into wire and hose, and sold.	.....
	Roofing—car	Converted	Made into tinware, paint buckets, indicator number cases, torpedo and flag cans, car ventilators, roof plates, sand scoops, signs, dope buckets, smoke jackets, refuse cans, oiling buckets, hot-box coolers, material racks, sand buckets, coal scuttles, etc.	3,322.00
	Springs—coil	"	Heated, straightened, and made into buggy, jack and pinch bars.	.....
	Strainer boxes	Reclaimed	Threads machined off, built up by acetylene blowpipe and rethreaded at 35 per cent cost of new.	.....
	Superheater units	"	Bends and ball joints renewed.	.....
	Tires—steel	Converted	Made into heel and toe ends of claw bars, into lining bars, pick points, etc.	.....
	Valves	Reclaimed	Rethreaded and reground.	.....
	Wheels—C. I.	"	1,140 reground.	4,389.24
Track Material	Frogs	"	135 by acetylene welding blowpipe.	8,355.37
	Rail joints	"	19,150 repaired.	28,000.00
	Spikes—track	"	470,000 heated and straightened.	8,235.00
	Switch points	"	1,219 by acetylene welding blowpipe.	20,255.10
	Tie plates	"	32,000 repaired.	3,500.00
	Ties	Sold	To employees.	8,602.94
Tools and Supplies	Batteries	Scrapped	Zinc and brass sold.	12,680.41
		Converted	Wax made into sealing wax.	.....
	Lanterns—hand	Reclaimed	581 repaired.	402.45
	Paint brushes	Reclaimed or scrapped	Old brushes used to paint castings, patterns, etc. Handles finally sold.	297.00
	Shovels	Reclaimed or converted	10,904 fitted with new handles, or blades welded. Others made into stove shovels. Cost is 54 per cent of new.	7,368.90
	Wrenches—track	Reclaimed	2,585 repaired.	2,360.00
Fuel	Charcoal dust	Sold	To outsiders.	317.34
	Coal screenings	"	" "	520.50
Wood	Lumber	Reclaimed	615,000 bd.-ft. reclaimed.	18,000.00
	Wood—scrap	Sold	To employees.	8,879.54
Textiles	Rags	Reclaimed	Boiled in lye with live steam, dried and reused.	192.76
	Waste	"	Cleaned, carded, boiled in oil and reused.	91,894 37
Containers and Packing Materials	Barrels	"	Recoopered, cleaned and used for storage, fire protection or making shipments.	5,698.00
	Barrels—lime	Returned	To manufacturers.	1,270.40
	Barrels—paint, oil and grease	"	" "	1,640.00
	Burlap	Reclaimed	Used for packing and for heading barrels of material.	129.26
	Cans—5 gal.	"	Repaired, resoldered and used in shipping.	4,903.23
	Carboys	Returned	To dealers.	3,239.00
	Paper—sheet	Bulk purchase	Formerly bought in special sizes. Now bought in commercial sizes, and cut on automatic machines.	3,000.00
	Paper scrap	Sold	To dealers.	2,336.00
	Reels	Returned	To manufacturers.	1,559.40
	Rope, twine	Reclaimed	Reused to tie up packages.	4,118.00
	Sacks—cement	Returned	To manufacturers.	31,094.04
Miscellaneous	Coffee cans	Converted	Drinking cups, grease cans, etc.	.....
	Firebrick	Scrapped	Sold to manufacturers.	3,696.76
	Hides	.....	.....	29.60
Office Supplies	Office forms	Converted	Made into scratch pads, which formerly were bought in sizes required.	1,350.00
	Stamp pads	Made	Were formerly purchased.	200.00
	Typewriter spools	Sold	To dealers.	45.00
	Typewriter oil	Bulk purchase	Formerly bought in small cans. Now bought in bulk.	61.00

Building Production Schedules from Sales, Costs and Profit Analyses

Working Plans for Profits—VII

By G. CHARTER HARRISON

Member of the Firm of Stevenson, Harrison and Jordan, Management Engineers

NEARLY three centuries ago Æsop told his familiar fable of the man, the boy, and the donkey, the moral of which is that, it being impossible to please everyone, the path of wisdom is to try to please oneself. This fable came to my mind a short time back when I received two letters within a day or so of one another, both commenting upon a series of articles which I had written. The first writer complained about what he termed "the unnecessary detail in your diagrams, which I find very confusing," the other protested that I did not give sufficient detail in my diagrams to enable him to apply the methods I advocated to meet the special requirements of his own business.[1]

No conscientious writer ever succeeds in satisfying himself—even that exemplar of painstaking effort, Doctor Johnson, who, practically unaided, carried to conclusion the stupendous undertaking of his dictionary, once stated to Sir Joshua Reynolds:

> There are two things which I am confident I can do very well: one is an introduction to any literary work, stating what it should contain, and how it should be executed in the most perfect manner; the other is a conclusion, shewing from various causes why the execution has not been equal to what the author promised to himself and to the public.

In a series of articles such as the series of which this is the concluding instalment, it is obvious that it is impossible to present detailed plans which will meet all possible conditions, and therefore there are only two courses open to a writer, one of which is to deal entirely with principles and generalities, while the other is to take a middle path and state principles and illustrate their application in specific cases in sufficient detail to convey clearly to the mind of the student the general *modus operandi* to be followed in applying these principles to meet concrete problems.

It seems to me that there is far too much technical literature, the scope of which is confined solely to the enunciation of general principles, and this particularly applies to the literature of cost accounting. It is of course far easier to write a general article than it is to develop one with more or less elaborate illustrations but the result usually is to bear out the truth of the proverb "easy writing makes cursed hard reading."

The diagrams which have been given with this series illustrate the application in a specific case of the essential principles involved in operating a business for maximum profits. There are two fundamentals involved:

1. The setting of definite objectives.
2. The provision of means for determining at all times to what extent the objectives have failed of realization and the causes of such failure.

FIG. 15. REQUIREMENTS OF COLUMBUS BRANCH BY MONTHS

Product	Mach. No.	Inventory 1st of Year	January Sales Estimate	Balance Over or Short	February Sales Estimate	Balance Over or Short	Etc.
Planters	28	15	8	7	9	2*	
	29	12	7	5	8	3*	
	30	4	6	2*	7	7*	
Total		31	21	10	24	12*	
Cultivators	50	2	6	4*	15	15*	
	51	1	5	4*	11	11*	
	52		5	5*	11	11*	
Total		3	16	13*	37	37*	
Etc.							

* Indicates short.

FIG. 16. NET REQUIREMENTS FOR MACHINES BY MONTHS

Product	Mach. No.	Factory Inventory 1st of Year	Branch Shortages January					Net Balance Over or Short	Etc.
			Col.	D.M.	F.	K.C.	Total		
Planters	28	20		3	1	10	14	6	
	29	4		1	2	6	9	5*	
	30	15	2	4	2	3	11	4	
Total		39	2	8	5	19	34	5	
Etc.									

* Indicates short.

[1] For previous articles see MANAGEMENT AND ADMINISTRATION for October 1924, p. 361; November 1924, p. 491; December 1924, p. 605; January 1925, p. 4; February 1925, p. 165; March 1925, p. 249.

These two principles, of course, underlie success in any undertaking, whether it be the construction of a battleship, the conduct of a political campaign or the development of an invention. As scientific knowledge increases, the opportunities for chance discoveries become more and more rare, excellent illustrations of which are the inventions of Major Armstrong, the first of which, regeneration, he practically stumbled on in the early days of radio, while, in contrast, his later inventions—the super-regenerative and superheterodyne circuits—were the results of deliberate attempts to achieve certain results, and involved intensive experimentation and an exceedingly high order of scientific knowledge.

The chances of "stumbling" upon extraordinary success in business are becoming rarer as the science

FIG. 17. PART REQUIREMENTS BY MONTHS—PLANTERS

Part No.	Parts per Mach.			January				February				March				April				Etc.
				Part Requirements				Part Requirements				Part Requirements				Part Requirements				
	No. 28	No. 29	No. 30	No. 28	No. 29	No. 30	Total	No. 28	No. 29	No. 30	Total	No. 28	No. 29	No. 30	Total	No. 28	No. 29	No. 30	Total	
Machines short					5	....	....	41	41	41	.....	45	37	42	.....	41	33	39	.....	.....
313	1	1			5		5	41	41		82	45	37		82	41	33		74	
315	2	4	4		20		20	82	164	164	410	90	148	168	406	82	132	156	370	
316	1	1	1		5		5	41	41	41	123	45	37	42	124	41	33	39	113	
318	5	5	5		25		25	205	205	205	615	225	185	210	620	205	165	195	565	
Etc.																				

FIG. 18. INVENTORY OF PARTS IN INVENTORY

Assembly No.	1357		1358		1360		1364		1365		Total Parts in Assembly	Part Inventory (Unassembled)	Total Parts Inventory
Inventory	50		20		15		10		20				
Part No.	Parts per Each	Total	Parts per Each	Total	Parts per Each	Total	Parts per Each	Total	Parts per Each	Total			
313	1	50	1	20	2	30	1	10	3	60	140	20	160
315	2	100			5	75	4	40	1	20	300		300
316	1	50	2	40							150	100	250
318					1	15	2	20	1	20	200	100	300
Etc.													

of business develops—and in this connection I cannot refrain from referring again to Herbert Spencer's dictum:

> Just as fast as productive processes become more scientific, which competition will inevitably make them do . . . so fast will scientific knowledge grow necessary to everyone.

We see today to some extent in New England the unfortunate results of a lack of appreciation of the importance of keeping business in line with the developments of industrial science. New England manufacturers as a whole have not realized as fully as their competitors in the Middle West that the methods of 20 years ago are not suitable to meet the needs of today, and as a result of this spirit of excessive conservatism many a once profitable business is today losing money or making relatively small profits. I call to mind an illustration of the calamitous effects of what I may term "mental dry rot" in a business over half a century old, which had formerly earned substantial profits but had degenerated until the profit and loss account showed several hundred thousand dollars on the wrong side of the sheet. This business was operating wholly without objectives—the sales manager had no clear conception of the sales possibilities of the business, and the treasurer confided to me that he did not believe in cost systems. The introduction of a system of standard costs disclosed the fact that the manufacturing costs were excessive to a ludicrous degree, and the result of introducing a system of sales quotas was an increase in sales of 155 per cent. Incidentally it may be mentioned that both the treasurer and sales manager of this company were strong supporters of the new policies after the situation had been analyzed and the proposed plan of action was clearly laid before them. In this case it was possible to save the business because the corrective measures were applied in time, but in many cases the manufacturer waits too long—deludes himself with the belief that better times will come—until at last the inexorable law of the survival of the fittest gets into operation, and the shutters go up for the last time.

Forecasts of sales, costs, and profits are the foundation for the plans and activities of all divisions of a business. With a forecast of net profits by months[2] before him, any competent accountant should be able to prepare forecasts of the monthly balance sheets. The forecast of net profits by months also serves as the foundation for the production schedules of the factory manager and the buying schedules of the purchasing department. The process involved in the preparation of the production schedules is primarily

[2] See MANAGEMENT AND ADMINISTRATION, December 1924, p. 607, Fig. 9, Form C.

FIG. 19. NET PART REQUIREMENTS BY MONTHS

PART NO.	INVENTORY	JANUARY		FEBRUARY		MARCH		APRIL		ETC.
		Required	Over or Short	Required	Over or Short	Required	Over or Short	Required	Over or Short	
313	160	5	155	82	73	82	9*	74	74*	
315	300	20	280	410	130*	406	406*	370	370*	
316	250	5	245	123	122	124	2*	113	111*	
318	300	25	275	615	340*	620	620*	565	565*	
Etc.										

* Indicates short.

one of analysis, the major operations involved in the agricultural implement business, which was chosen for illustrative purposes in the diagram, for instance, being as follows:

1. Determine requirements of branches by months after taking into account machines carried over from previous year (see Fig. 15).
2. Determine total net requirements by months after taking into account machines carried over at factory from previous year (see Fig. 16).
3. Figure machine requirements in terms of parts (see assembly cost sheets,[3] and Fig. 17).
4. Tear down factory inventory of assemblies into terms of parts[4] and add to this the inventory of unassembled parts (see Fig. 18).
5. Deducting the inventory of parts obtained in Fig. 18 from the monthly part requirements as shown on Fig. 17 gives the net part requirements, or the parts to be manufactured per Fig. 19.
6. The net part requirements by months as shown on Fig. 19 are listed on the part manufacturing schedule (Fig. 20) in the Requirements column. In the Make column are entered the quantities scheduled to be made by months, these scheduled figures being based upon the requirements by months and the standard manufacturing quantities, shown in the column so headed. Parts will require, of course, to be manufactured considerably ahead of the requirement dates to allow for assembling and shipping the machines to the branches. For instance, part number 313 according to Fig. 19 will not be required until March, but the manufacturing schedule (Fig. 20) calls for 100 of these parts to be completed in January.

At this point it should be noted that in scheduling the production of parts, consideration will have to be given to the producing capacity of the factory. This is a simple matter when a properly designed standard cost system is in force; if reference is made to the standard part cost and rate sheet[5] it will be noted that this form provides for listing the standard time allowances for the performance of each operation on a part, and accordingly little difficulty will be experienced in converting the production schedules shown in Fig. 20 to terms of standard hours as is shown in Fig. 21.

The standard hours shown on Fig. 21, of course, are for the factory as a whole, and in many instances when the product is of varied character it will not be found necessary to make any finer analysis than this. In any event it will rarely be found desirable to go into the exceedingly fine detail formerly considered necessary by production managers where the production schedules were analyzed by individual machines. In planning production the principle of exceptions can

[3] See MANAGEMENT AND ADMINISTRATION, January 1925, p. 43, Fig. 11, Forms M and N.

[4] See MANAGEMENT AND ADMINISTRATION, January 1925, p. 43, Fig. 11, Forms M and N.

[5] See MANAGEMENT AND ADMINISTRATION, January 1925, p. 43, Fig. 11, Form L.

FIG. 20. PART MANUFACTURING SCHEDULE

PART NO.	STANDARD MFG. QUANTITY	JANUARY		FEBRUARY				MARCH				APRIL				MAY	
		Requirements	Make	Balance Over or Short	Requirements	Total Over or Short	Make	Balance Over or Short	Requirements	Total Over or Short	Make	Balance Over or Short	Requirements	Total Over or Short	Make	Balance Over or Short	Etc.
313	100		100	100		100		100	9	91		91	74	17		17	
315	600		600	600	130	470		470	406	64	600	664	370	294		294	
316	200		200	200		200		200	2	198		198	111	87	200	287	
318	1,000		1,000	1,000	340	640		640	620	20	1,000	1,020	565	455		455	
Etc.																	

FIG. 21. CONVERSION OF PRODUCTION SCHEDULES TO TERMS OF PLANT CAPACITY

PART NO.	STANDARD TIME PER 100		JANUARY		FEBRUARY		MARCH		APRIL		ETC.
	Hr.	Hundreds	Scheduled	Standard Hr.	Scheduled	Standard Hr.	Scheduled	Standard Hr.	Scheduled	Standard Hr.	
313	1	40	100	140							
315		50	600	300			600	300			
316		50	200	100					200	100	
318		20	1,000	50			1,000	50			
Etc.											

be followed to great advantage and the requirements against machines figured only for those pieces of equipment which are known as the "neck of the bottle."

7. Based upon the part manufacturing schedule, the material requirements are figured by months, this necessitating converting the parts as scheduled on Fig. 20 to terms of materials, and obtaining the requirements for each kind of material by months. Deducting the materials on hand from these requirements (in a similar manner to that followed in figuring the net part requirements on Fig. 19) will give the material requirements by months. Allowance will, of course, be made for the time required to obtain material a reasonable time ahead of the factory requirements. Consideration will be given to the necessity in some cases for ordering material to cover several months' requirements, and this will apply particularly to steel and special materials.

A plan such as has just been described renders it practically impossible to accumulate stock of obsolete material or parts. The schedules, being based upon sales estimates, would require to be modified to conform to revisions of the sales estimates. In the agricultural implement industry, which has been used for illustrative purposes, where the sales are very dependent upon the crops, the manufacturing program at the outset would probably only include half of the estimated requirements, the balance of the year's manufacturing being scheduled in accordance with the sales estimates as revised on the basis of the government crop forecasts.

Economies of Fiber Shipping Containers

By H. D. CORNWALL

Chairman, Committee on Forest Conservation, National Container Association

APPROXIMATELY 1,500,000 tons of fiber board were manufactured into solid fiber and corrugated shipping containers in 1923, a year of subnormal production in the industry. At the same time, this annual volume has not materially lessened the use of box lumber for the shipment of such materials as are shipped in wooden boxes. Rather, the growth of the fiber container industry has taken up the slack or absorbed the increased demand for shipping packages, so that the total number used for the manufacture of boxes has remained about constant. The use of fiber boxes, however, has been estimated by the Department of Commerce as saving in the neighborhood of a billion feet of lumber annually. Incidentally, it has also made an increased market for waste paper, which itself is the raw material used in greatest volume in the manufacture of fiber containers.

The increased cost of lumber makes the problem of the shipper who has previously used wood boxes increasingly serious. The use of fiber or corrugated boxes in place of wood, on the contrary, not only effects an economy to the shipper in a lessened first cost, but directly contributes to the general national forest conservation program.

Savings of $152,500 Possible in One Case

In a recent survey of one particular factory of an industry, the product of which is shipped almost entirely in large wood packing cases, the possible saving by the use of fiber or corrugated containers brought out some rather startling figures. The change to fiber from the wood box, over the period of 1923, which in that particular industry was a lean year, showed a possible saving of approximately $110,000 in first cost, a very considerable saving in labor, handling and storage space, and a difference of 1700 tons in outgoing freight weights for the period. In this particular industry the customers pay the freight, and as the product takes first-class rate, a conservative average of $1.25 per 100 lb. would have effected a saving of $42,500 to the customers, who in this instance are the retailers.

The retailer may not feel close to the problem of forest conservation, but he certainly feels close to a saving in freight, and thus obviously may become a real factor in the broad problem of national forest conservation, while at the same time serving his own personal interests. Incidentally, the retailer who has been procuring commodities formerly shipped in large wood packing cases is enabled, in buying through a manufacturer whose product is shipped in smaller units, to procure a better assortment of stock, while tying up less capital.

Materials Continually Reused

A very small proportion of the tonnage of fiber board which goes to make up the total converted into solid fiber and corrugated containers for shipping purposes originates from our native forests. Conservation in the container industry as a whole becomes a matter of rotation, in that very large percentages of containers used for the shipment of commodities go, after original use, to the hands of the paper stock dealers, and from them back to the mills, where they are again beaten up and once more go into the make up of containers. This process is continuous.

The freight saving is not the loss to the railroad companies that it might at first appear to be, as fiber containers are handled with very much greater economy of space and rolling stock. If it were not for the present extensive use of solid and corrugated fiber containers which have taken the place of wood boxes, the rolling stock of the railroads would, without doubt, be entirely inadequate to handle the increased bulk.

Check Wage Payments Avoid Hold-Ups

Adopted After Bank Objects to Deposit Slip Plan

By EDWARD S. WAGNER

Treasurer, Scott Paper Company

THE growing number of hold-ups and the frequency with which they were successful led the Scott Paper Company to adopt first a deposit slip plan of wage payment, and later a check system, both of which removed all danger from this source. The plant is located in the industrial district of Chester, Pennsylvania. To reach it one has to pass down a street readily accessible from the "downtown" section, in which a negro and foreign population are congregated. No attempt was ever made to seize the pay-roll, but as it was evidently a temptation to habitués of the neighborhood, positive prevention of such an event was deemed the wisest plan. Moreover, it was unfair to ask any employee to risk his life protecting the company's money when running this danger was unnecessary.

Deposit Slip Method of Payment

Hence, at first, an arrangement was entered into with the company's employees and one of the local banks under the terms of which the weekly pay-roll was deposited by check in a lump sum with the latter institution. Employees received deposit statements in lieu of cash or individual checks as wages, and a duplicate of each of these statements was sent with the total pay-roll check to the bank. These duplicates served the same purpose as if made out in connection with deposits by individuals, that is, a checking account was opened up in the name of each employee, and his weekly pay was credited to this account.

The plant has about 400 employees, about 35 per cent of whom are skilled workers, 25 per cent are girls, and the remainder are office employees or ordinary laborers. Nationalities are distributed in the ratio of about 75 per cent American to 25 per cent foreign.

Starting the Plan

The deposit slip plan of wage payment was applied to the entire force in November 1921. Two weeks before its introduction a meeting of all the day employees was called, and other meetings were held for the men on the paper mill shifts, 7 A. M. to 3 P. M., 3 P. M. to 11 P. M. and 11 P. M. to 7 A. M. At all of these meetings the proposal was carefully explained and was finally agreed to by the workers.

The idea was at first looked upon somewhat with suspicion. Employees were inclined to believe that the company had some ulterior motive in view, or perhaps might have been conniving with the bank to increase its depositors, both of which were, of course, entirely unfounded theories. What really won the rank and file over was their sense of fair play. When the personal risk that the pay-roll messenger ran was thoroughly realized, no one was willing to stand in

Scott Paper Company

VOUCHER NO._____ CHESTER, PA._____ NO. PD_____

PAY

	EARNINGS FOR WEEK ENDING	IN SETTLEMENT OF ACCOUNT AS FOLLOWS HRS.	GROSS DEDUCTIONS	NET

TO

OR BEARER

Scott Paper Company

(SPECIAL DISBURSING ACCOUNT)

TO THE CAMBRIDGE TRUST COMPANY

CHESTER, PA.

DISBURSING CLERK

FIG. 1 SPECIMEN CHECK USED IN THE PAYMENT OF WAGES

the way of putting the plan into immediate effect.

For a while there were some complaints from employees regarding the amount of their pay as compared to the cost of living. Probably they had never thought of the relative sizes of their various items of expenditures before, but a checking account brought this question up. Patient explanation, however, adjusted all these difficulties, and no unpleasantness ever arose under the system between company and employees.

The company benefited from the plan because it was free from the hazard to life and property. Moreover, the handling of a lot of currency on two pay days was avoided. The making out of deposit slips took no more time nor labor than the preparation of pay envelopes. But one person in two hours could get ready to hand out the slips, whereas formerly the making up of the cash took two girls three hours. Actual paying off, of course, required the same amount of time under both methods. Hence at least four hours of clerks' time was saved each week.

From the employees' standpoint the main advantages were in the encouragement to practice thrift and to follow some sort of budgeting plan for personal expenses. Not all of the tradesmen in town would accept checks made out by employees in payment of bills, as they had been flimflammed out of money by impostors on several occasions and hence were very suspicious. The company itself cashed checks up to $12 for employees if they applied at the office. Many went to the bank, which is about five blocks away, in person for this purpose during lunch hour, or had members of their families do so in banking hours. This is the feature which caused the bank to ask for a discontinuance of the plan.

The bank, while not called upon to handle currency on Thursdays and Fridays, as formerly, to make up the pay-roll for the week ending the previous Saturday, had to maintain between 300 and 400 additional checking accounts, on many of which there was probably no profit. Employees were at liberty to draw their entire weekly salary out at once on check, and many did this. Others began to pay bills by check, and consequently kept a bank reserve, in the handling of which the bank perhaps broke even. Many employees learned the lesson of thrift and established savings accounts, on which, of course, the bank earned money. Many also joined the Christmas Club, to which they had not been attracted before.

But the physical facilities of the bank were limited, and the bank's other customers were seriously inconvenienced because of the increased demand upon the teller's time due to the large number of the company's employees and members of their families who called at the window during rush hours. It was not deemed profitable to set up another teller's window, and so the bank asked the company to discontinue the plan.

No other bank was willing to take it up, but the company still did not want to go back to the cash payment system. Hence the check method of payment was adopted.

A special account for disbursements only is run at the Cambridge Trust Company. In this account is deposited just enough to cover the pay-roll and other disbursements on Tuesdays and Fridays. On these days checks are drawn to a total which exhausts the credit established.

SCOTT PAPER CO., DEPT . . . . . # . . . . .

CHESTER, PA. DATE . . . . . 192 . . . .

Gentlemen:

Please retain $ . . . . . per week starting . . . . . 192 . from my pay envelope and place to my credit in the . . . . . Bank—Savings Department.

The bank is to pay 3% interest and repay my savings at any time after customary notice.

Deductions are not to be made if my weekly earnings are less than $14.00 per week. Furthermore this plan can be discontinued at any time I desire.

Signed . . . . . .

Witness . . . . . .

FIG. 2 AUTHORIZATION FOR DEDUCTING SAVINGS DEPOSITS

The deposit checks for this account are signed in the usual way by officers of the corporation. The disbursement checks for pay-roll and other purposes are signed by a disbursing clerk, who is bonded in the usual manner. The checks he signs (see Fig. 1), however, have been already cut on a check perforator, and the signed checks are compared with the invoices and pay-roll vouchers by the treasurer. This method saves the time of the corporation officials and is as economical of clerks' time as the deposit slip payment scheme and adequately supervises and protects disbursements.

Realizing that, in general, a thrifty employee is a better and more intelligent workman, less liable to leave, be absent, or get hurt, than his more shiftless co-worker, the company also encourages a savings plan, the details of which can be understood from Fig. 2. This form, when filled out, signed and witnessed, gives the pay-roll department authority to deposit at the bank, in the individual savings account of the employee concerned, a definite amount each week. The difference between this amount and the week's earnings is, of course, paid to the employee by check. No pressure is used to induce workers to follow this plan. Persuasion and an occasional form letter or personal word of encouragement have led an average of 40 of them, or 10 per cent, to maintain savings accounts at the bank under the arrangement outlined above.

Worthington Methods for Tool Storage, Use and Repair

By ANKER L. CHRISTENSEN

Engineer, Tool and Material Storage Department, Worthington Pump and Machinery Corporation

TOOL control in a factory depends upon so many factors that a preliminary analysis of local conditions is generally necessary before deciding upon a system. This analysis should cover: (1) Physical lay-out of the factory; (2) kinds and arrangement of machine tools used; (3) nature of the product and methods of manufacture; and (4) the class of workmen employed.

In locating cribs, as well as in determining the number needed, consideration should be given to:

1. *Size and lay-out of the factory.* The cost of tool distribution from the single central tool crib may be excessive in large factories.
2. *Allocation of space to departments.* One section of a factory is sometimes given over to assembly and testing, while others are used for fabrication of parts. Relatively few tools are needed in the former, while the latter may require the use of every kind of tool that the factory owns. Obviously, cribs should be placed nearer to the departments that use the most tools.
3. *Nature of the product.* Some products lend themselves to complete fabrication, assembly and test in a single department. In cases where a department functions independently of the rest of the factory, it may be advisable to have a tool crib solely for its use.
4. *Methods of operation.* In factories where process methods are used, such as textile mills or cement plants, the tool requirements are very different from those of a highly developed machine shop.
5. *Grade of workmen employed.* High-grade workmen take pride in good tools and are generally careful in their use. This is not always the case with machine attendants, especially if they are on piece work. As a rule factories that use piece work have a more complex tool problem than those that operate on day rate.

Tool selection should be worked out in connection with the manufacturing processes used in each individual shop. In general, there are two methods used to determine what tools are needed for an operation:

1. The workmen determine the tools necessary when assigned to the job.
2. Predetermined tool lists are worked out by experts employed for that purpose.

In jobbing machine shops or repair shops where the same operation is seldom repeated and where the workmen are high-grade mechanics, the former method usually proves the more satisfactory. On the other hand, in factories where manufacturing is done on a production or stock basis and orders for the same work are repeated many times a year, the second method will usually show the following advantages:

1. It will save time, as carefully worked out tool lists will serve indefinitely.
2. It will insure proper tool selection, for piece work operators are not usually competent to select the tools best suited to the purpose.
3. It will keep machine tools in operation a greater percentage of the time, since they will not have to stand idle while the workman is trying to decide which tools to use.

The next problem is to provide workmen with the tools where and when needed. There are several ways of accomplishing this:

1. Allowing the workmen to keep in their possession all the tools necessary for their use.
2. Having the workmen go to the tool crib for tools.
3. Sending the tools to the workmen.

Each method has its advantages, and all three may be used in a single factory. In the erection, assembly, and test departments, workmen have constant use for wrenches, hammers, chisels, punches, screw drivers, etc. Such tools should be issued to the men in a kit that will meet their particular requirements, and any special or extra tools may be obtained from the tool crib as the need arises.

The practice of having workmen go to the tool crib for their tools is common in many factories. It should be borne in mind that the time spent by a man going for tools and drawings is a direct loss to production, not only in wages paid to workmen but also in the stand-by burden loss on machine tools.

Table 1 gives some idea of the distance that the central tool crib is from the mid-points of the various departments of one factory, the Worthington Works, of the Worthington Pump and Machinery Corporation, at Harrison, N. J.[1] From this diagram, it will be noted that from the J and R departments, a man must walk 1200 ft., or nearly a quarter of a mile, to get tools. Other production departments, such as C, D, E, F, G, and H, range from 300 to 500 ft. from the tool crib. This makes a total distance of 600 to 1000 ft.

[1] Hereafter referred to simply as Worthington Works.

TABLE 1. STUDY OF TIME REQUIRED BY WORKMAN TO GET TOOLS, FIXTURES AND BLUE-PRINTS

Shop	Distance to Tool Crib Feet	Distance to Jig and Fixture Room Feet	Distance to Blue-Print Room Feet	Time to Walk to Tool Crib and Return* Min.	Time to Walk to Blue-Print Room and Return Min.	Time to Walk to Jig and Fixture Room and Return Min.	Time to Issue a Blue-Print Min.	Time to Issue a Jig Min.	Time to Issue One Tool Min.	Average No. of Tools Issued per Man	Average Time to Serve a Man Including Delay Min.	Time for Man to Get Tools Min.	Time for Man to Get Tools and Blue-Print Min.	Time for Man to Get Tools, Blue-Print and Jig Min.
C	500	370	370	4	3	3	1	2	1	3	4	8	11	13
D	400	380	380	3.5	3	3	1	2	1	3	4	7	10	12
E	390	240	240	3	2	2	1	2	1	3	4	7	9	9
F	500	300	300	4	2.5	2.5	1	2	1	3	4	8	10.5	12.5
G	500	580	580	4	5	5	1	2	1	3	4	8	13	15
H	300	400	400	2.5	3	3	1	2	1	3	4	7	10	12
J	600	470	470	5	4	4	1	2	1	3	4	9	13	15
K	400	275	275	3.5	2	2	1	2	1	3	4	7	9	11
L	200	100	100	1.5	0.5	0.5	1	2	1	3	4	5	5.5	7.5
M	200	100	100	1.5	0.5	0.5	1	2	1	3	4	5.5	5.5	7.5
N	250	250	350	2	3	3	1	2	1	3	4	6	9	11
O	300	400	400	2.5	3	3	1	2	1	3	4	6.5	9.5	11.5
P	375	275	275	3	2	2	1	2	1	3	4	7	9	11
Q	450	640	640	3.5	6	6	1	2	1	3	4	8	14	16
R	600	650	650	5	6	6	1	2	1	3	4	9	15	17
S	300	200	200	2.5	2	2	1	2	1	3	4	6.5	8.5	10.5
T	50	300	300	0.5	2.5	2.5	1	2	1	3	4	4.5	6.5	8.5
U	625	525	525	5	4	4	1	2	1	3	4	9	13	15
V	500	550	550	4	4.5	4.5	1	2	1	3	4	8	12.5	14.5
W	1070	970	970	8	7.5	7.5	1	2	1	3	4	12	19.5	21.5
Y	250	350	350	2	3	3	1	2	1	3	4	6	9	11
Z	250	350	350	2	3	3	1	2	1	3	4	6	9	11

*Time calculations are average.

covered in going from the machine to the crib and return. The minimum time required for a man to determine what tools are needed and go to the crib for them, plus the time spent at the crib, varies from 5 to 15 min. in individual cases. Extra time is consumed where it is necessary to obtain blue-prints.

Table 2 gives some idea of the number of men who were served by the main tool crib per day in the factory mentioned above.

This table represents the average results of two weeks' study made in the main tool crib. For the five full working days of this period, an average of 562 men

TABLE 2. RECORD OF TOOL ISSUES IN ONE WEEK

Day	Number of Men Served	Number of Tools Given Out
Monday	626	1223
Tuesday	573	1236
Wednesday	551	1439
Thursday	616	1202
Friday	544	1208
Sat. (half day)	273	603
Sun. (part force)	114	214

came to the window for tools daily, indicating that practically every machine operator in the machine shop was required to go to the tool crib at least once a day.

With predetermined tool lists, it is possible for the crib personnel to deliver to the workmen the necessary tools where and when needed. The advantages of delivering tools are:

1. Machines are not standing idle while tools are being secured.
2. Crib laborers may deliver several sets of tools on each trip to a department. This is not the case where men go for their tools.
3. Tools and drawings may be delivered in advance of the time required. This gives the machine operator an opportunity to study set-up instructions during the idle moments of the preceding operation.

Conditions in most factories are such that distribution of tools along the following lines seems most practicable:

1. *Departments that fabricate parts for stock.* The workmen in these departments should have every tool delivered by the tool crib personnel from predetermined tool lists.
2. *Assembly, erection and test departments.* In these departments, the men should be given a kit of tools sufficient for their general use. Any special ones needed should be drawn from the crib as occasion requires.
3. *Tool room and machine tool repair shop.* The situation in these shops is much the same as in the jobbing machine shop, and the use of predetermined tool lists would be impracticable. The tool makers are well qualified to determine what tools are needed for the work at hand. The distribution of tools in these departments may be done by messengers, either from the respective departments or from the tool crib. In some cases it may be necessary for the tool maker to go personally to the crib for tools.

Tool Classification

There are many different methods of classifying tools, all of which are similar to, or are a combination of, one of the three following systems:

1. Straight numbering of tools and placing the numbers on the drawings.
2. Classified numbering of tools (Dewey decimal system).
3. Mnemonic lettering system.

Straight numbering consists of running a series of consecutive numbers on all special tools. Generally, such tools as drills, taps, and reamers are specified by their names. An index is kept of these numbers which gives information as to the nature of the tool and the operation for which it was designed. This system, in spite of its general use, has many inherent disadvantages. It is impracticable to keep the tools in the crib by number, because two consecutive numbers may —and usually do—represent tools of a very different nature.

Attempts have been made to make this straight numbering system more efficient. One method is that of placing the tool numbers on the drawings. When a certain drawing is given to the workman, he has

TABLE 3. NUMERICAL KEY SHEET (DEWEY DECIMAL SYSTEM)
(Applied to general classes of tools.)

1. Sharp edge tools.	All tools that work by cutting off material, except chisels and blanking tools.
2. Measuring devices.	All gages and instruments of precision.
3. Jigs and fixtures.	All tools used for duplicating work such as jigs, fixtures, etc.
4. Impact tools.	All tools that work by impact, including chisels, hammers, etc.
5. Wrenches.	All tools that work by causing rotation.
6. Holding tools.	Clamps of all kinds, mandrels, nuts, dogs, etc.
7. Fire tools.	All tools that are used for melting, heating, welding, etc.
8. Transportation tools.	All tools that are used in moving materials.
9. Miscellaneous.	All tools not otherwise classified.

only to list the numbers of tools that are needed for the particular operation he is to perform from the drawing and then present this list to the tool crib for the necessary tools. Even this improvement has the following disadvantages:

1. Considerable time is lost in consulting the index to ascertain what kind of tool the number on the drawing refers to.
2. It is difficult to keep numbers up to date on the drawings, and errors are constantly creeping in, because methods of machining are changing continually, which necessitates re-design of tool details, and consequent changes in the numbers.

Classified Numbering (Dewey Decimal System)

In this classification certain digits, generally the first of the number, represent a class of tools. Table 3 gives a better idea of the system.

Each group may be subdivided indefinitely. To illustrate, a further division of the sharp-edged tools follows:

1.1	Drills
1.11	Twist drill
1.112	Taper shank twist drills
1.1123	High speed twist drills with taper shanks
1.11234	High speed taper shank twist drill of standard length.
1.2	Taps
1.21	U. S. Standard taps
1.212	U. S. Standard taps with machine shanks
1.2123	U. S. Standard taps high speed with machine shanks.

Simply by continuing to add digits to the key number, it is possible to classify tools to as small a variable difference as is desired. This system has two inherent disadvantages:

1. Only 10 variables can be provided for in each division.
2. Numbers are hard to remember, especially when they run into 7 or 8 digits.

Many other schemes and combinations of number classifications may be worked out but they will have the same weaknesses.

Mnemonic Lettering System

The theory of the mnemonic lettering system, as worked out by Frank B. Gilbreth, and stated in his own words, is: "All tools that are alike shall be together, and those that differ by one variable only shall be contiguous."[2]

Table 4 is the key sheet of the general tool groups under this system. It will be noted that tools are arranged alphabetically as well as mnemonically, i. e., the H group is for hammers and tools that function by striking or being struck. Likewise, under M will be found all tools used for measuring.

To classify a tool or to find a symbol for one already classified, first consult the general key sheet for the class to which the tool belongs. Then divide each general class into its natural subdivisions, i. e., the drilling and boring group, under D, consists of drills, counterbores, lathe-boring tools, counter sinks, reamers, taps, etc. Each of the component groups may be divided and subdivided until every important variable of a specific group has been covered. The complete symbol for a high speed taper shank twist drill would be DDTTHR. Table 5 shows how this symbol is worked down. The letter Z of each head sheet is left for special

TABLE 4. KEY SHEET FOR MNEMONIC CLASSIFICATION OF TOOLS

General Tool Groups	
0000–0049[1]	
A—Abraiding Tools.	All tools for filing, grinding, scratching, scraping, etc.
0050–0099	
B—Blanking Tools.	All tools for blanking, bending, drawing, flattening, piercing, shearing, swedging and trimming.
0100–0199	
C—Clamps and Holders.	Devices of all kinds, including bolts, nuts, screws and washers for holding work.
0200–0299	
D—Drilling and Boring Tools.	All tools that remove metal from interior, including drills, boring bars, cutters, lathe boring tools, reamers, taps, and holding devices for this class.
0300–0349	
F—Heating and Lighting Tools.	All tools used for melting, molding, tempering and annealing.
0350–0399	
H—Hammers.	All tools that work by striking or being struck.
0400–0499	
J—Jigs, Fixtures and Templates.	All instruments for duplicating work.
0500–0599	
M—Measuring Devices.	All gages and instruments of precision.
0600–0699	
P—Paring Tools.	All tools that remove chips from surfaces by cutting (except slotting and milling tools.)
0700–0749	
R—Revolving Cutters and Holding Devices	Including milling cutters, gear hobs, circular saws, etc., and holding devices for this class.
0750–0799	
S—Slotting Tools, etc.	Including back saw and slotting machine tools.
0800–0899	
T—Transportation Tools.	All tools used in moving materials, etc.
0900–0949	
W—Wrenches.	All hand tools causing rotation, except die holders and tap wrenches.
0950–0999	
Z—Special or Miscellaneous Tools.[2]	

[1] The numbers refer to accounting charges for tools, which will be explained later.
[2] F. B. Gilbreth, "Tool Classification."

[2] See also *Management's Handbook*, pp. 570-596.

tools of that division which cannot otherwise be classified. Definitions of gages, mandrels, arbors, collets, sleeves, sockets, jigs, fixtures, etc., may have to be worked out before tools can be correctly classified.

Gages. A gage, as defined by the Standard Dictionary, is "a standard of measure." An external gage is one that measures outside diameters or surfaces, and an internal gage measures inside diameters or surfaces.

Mandrels and Arbors. A mandrel is defined as a tool that holds work which is being turned in the lathe. An arbor is a tool that holds other tools while they are performing an operation, i.e., milling cutter arbors.

Collets, Sleeves and Sockets. The functions of these three classes are nearly identical. For simplicity, collets are defined as the adaptation tools for milling arbors, while sleeves and sockets are the adapters in the "drilling group" (drills, taps, and reamers).

Jigs and Fixtures. A jig is defined as a tool that guides other tools while they are performing cutting operations. A fixture is defined as a tool that holds work while operations are being performed on the work.[3]

The mnemonic lettering system has the advantage of having 24 special divisions for every group or class of tools. Also, the names of tools may be mnemonically connected to each symbol. Factories with a great many tools may build their tool symbol system upon this method as easily as those with only a few tools. Tools may be stored away in the tool crib according to the symbols in regular alphabetical sequence. This makes tools that differ by one variable only follow each other in regular order.

The Tool Crib

There are two methods of tool storage in general use throughout the United States, namely:

1. The large central tool crib into which all the factory tools are concentrated, and from which they are issued.
2. The sub-crib system. This method provides a central, or head, tool crib which acts more in the capacity of a storeroom than that of issuing tool crib. Each department, under this system, has a sub-crib which carries only the tools used by that department. When these sub-cribs need additional tools, they are requisitioned from the main tool storeroom.

The method best adapted to a shop depends upon the tool issue system used. The central tool crib system works to the best advantage if tools are to be delivered to the workmen by the tool crib personnel from predetermined tool lists. The sub-crib system is better adapted to cases where the workmen are required to go to the crib for their own tools.

With the sub-crib system, the distributing cribs should be so placed in the department that they will be most convenient to the workmen they serve. Generally, this is as near the foreman's desk or office as possible, so that when the men go to the foreman for assignments they may draw their tools without loss of time.

The location of the central crib is governed by a different set of conditions. Sufficient room to handle a large number of tools is essential. Room should be provided where:

1. Tool sets may be made up in advance.
2. Tools can be inspected and checked.
3. Tools can be adequately stored awaiting the next issue.

Everything else being equal, the central tool crib should be located as near the center of productive activities as possible, and where the tool delivery will not conflict with general transportation activities, and vice versa.

The amount of room needed varies with the number and variety of tools handled. The tool crib, being nonproductive, should be limited as regards floor space used. But over-economy in floor space tends to retard efficiency in getting tools in and out, and consequently holds up production. These general principles are of assistance:

1. Tools should not, as a general rule, be stored over 6 ft. high. The top sections of the bin should be left empty in the beginning to take care of additional tools of each class which are sure to accumulate as time goes on.
2. Tool sizes are given in dimension, number, weight, etc. For example, twist drills are made in size increments of $\frac{1}{64}$ in. Therefore, a rack for drills should have a space for each and every $\frac{1}{64}$ in. from the smallest to the largest size carried.
3. Aisle space between bins should be ample for the free passage of men through them. Thirty in. for bin aisles, and 36 in. for main aisles has been found ample.

Where the use of standard tools is adhered to, the space necessary to store them can be worked out quite accurately beforehand. Where no attempt has been made to use only standard tools, or to follow standard practices in manufacturing, liberal allowances should be made for special tools without disturbing the general layout of the standard tools.

TABLE 5. EXAMPLE OF MNEMONIC CLASSIFICATION OF TOOLS*

	D Drilling and boring tools		
	D Drills		
	T Twist		
	T Taper shank		
DDTT		**DDTTN**	
DDTTA		DDTTP	
DDTTB		DDTTQ	
DDTTC	Carbon steel	DDTTR	Regular
DDTTD		DDTTS	
DDTTE		DDTTT	
DDTTF		DDTTU	
DDTTG		DDTTV	
DDTTH	High speed steel	DDTTW	
DDTTJ		DDTTX	Extra long
DDTTK		DDTTY	
DDTTL		DDTTZ	Special
DDTTM			

*The letters I and O are omitted because they resemble figures.

(To be continued in the June issue.)

[3] *Machinery Handbook*, page 947.

Methods to Keep Inventories Down to a Minimum

Operation of an Inventory Control Department

By WILLARD J. GRAHAM

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THE Liquid Carbonic Company engages in the manufacture and distribution of a complete line of equipment and supplies for the carbonated beverage industry, including carbonic acid gas, soda fountains, syrups, crushed fruits, extracts and flavors, and automatic drink-dispensing devices and bottling machinery of all kinds. In addition to the main factory and general offices in Chicago, there are some 25 sales offices, gas plants and gas distributing stations all through the United States and adjoining territory, an organization capable of rendering complete service to the industry in question. The annual sales are about $8,000,000.

It is evident from this statement of the extent and varied character of the operations of the company that the problem of controlling effectively the amount and character of the inventory, which consists of raw material and parts stored at the main factory and finished goods stored at the main factory and at the branches, constitutes one of the major problems with which the executives of the company have to deal. This problem has in the past been the source of much difficulty, but is now being handled very satisfactorily by one central department through the methods and procedures outlined in the following.

The General Inventory Control Department

The primary function of this department is the central control of all inventory, both of raw and finished product, whether it be located at the main factory or at the branches. It does not include a central control of stores records, for neither stores records nor a perpetual inventory record is kept by this department. It exercises no direct line control and only a very indirect staff or functional control over the various stores clerks. The whole purpose of the creation of the department, and its principal function at the present time, is to keep all inventories over the entire organization at a minimum. This purpose it accomplishes by exercising a supervisory control over the issuing of all manufacturing orders, purchase requisitions and interdivisional orders, over shipments of goods to branches and the transfer of goods between branches. The department is not a large one. The head of the department and his assistant, and one or two clerks, perform this important function quite efficiently.

Before the creation of the general inventory control department a few years ago there had been no central control of stores. In consequence, the desire of the branch managers always to have goods enough on hand to insure immediate delivery, the desire of the factory division superintendents to keep their working force employed, and other contributing causes, resulted in excessive inventories all over the organization. With the drop in prices after the post-war period of prosperity, these inventories caused losses, with the result that the present attempt has been made to install a system of effective central control over all inventories.

Previous Attempts at Inventory Control

Of course there had been some control previous to this time. At the time of the periodic inventory report, excessive amounts of certain items would lead to comment and criticism on the part of executives, and recommendations would be made for the decrease in the inventory of these items. Such suggestions, or even orders, were not followed up closely enough to secure their execution, and therefore such control amounted to very little. At any rate such control is usually too late for any effective action.

The general problem of inventory control divides itself into two major parts: First, the control over the placing of purchase orders for raw materials and the issuing of manufacturing orders for parts, assemblies, or complete units of the finished product; second, the control of shipments of finished goods to the various branches for stock. Although these problems are very closely related to one another, for the sake of clarity they will be discussed separately.

The first step toward the solution of the first of these two problems was the analysis of the various products of the factory to determine (a) their component parts, and (b) the raw materials required in the manufacture of these parts. That is, every part was analyzed as to its raw material requirements, including quantity, quality, and proportion. Then the major assemblies and completed products were analyzed as to the number or quantity of such parts or raw materials necessary for the finished units of product. By such a method of analysis, the tabulated results of which are changed from time to time as changes are made in the product, it is possible to determine with a fair degree of accuracy the proper amounts of raw material or finished parts to purchase or manufacture in order to have ready for market a certain number or amount of the various finished products.

Such a system ties up very closely with, in fact is a part of, the general budget program. According to a very usual method of budgeting, the sales estimate is prepared first and is used as a basis for the preparation of the production budget. The production budget would equal in total for the year, but not for each month, the sales budget figure, the variation being due to the necessity of eliminating from production the peak due to seasonal fluctuations in sales and securing approximately uniform production throughout the year. In connection with the preparation of the production budget there is constructed for the head of the general inventory control department a factory schedule, not for minor parts, but for units of finished product classified by sizes, styles, etc. This schedule, in the form of a Gantt progress chart, is kept up to date by the assistant to the head of the department from information coming to him in the form of regular reports from the production and sales departments, as described below.

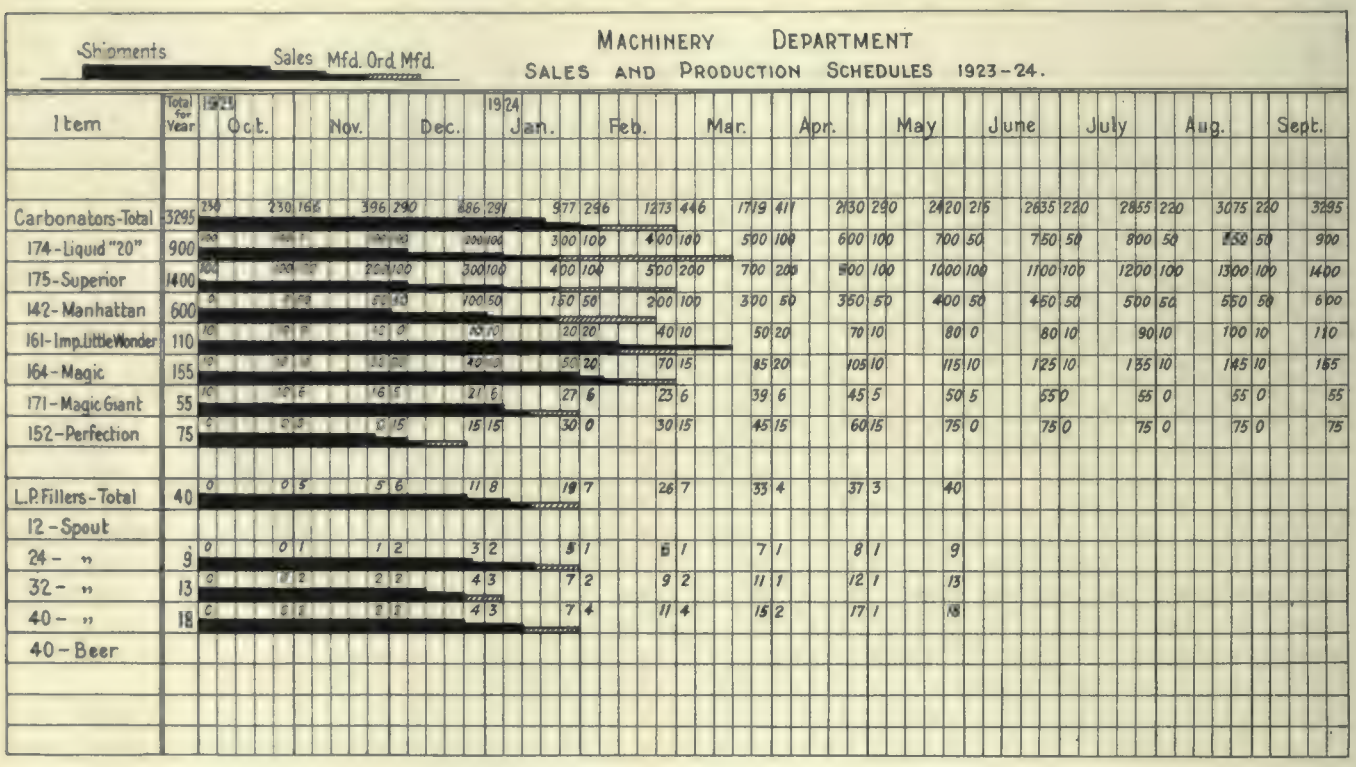


FIG. 1 MACHINERY DEPARTMENT SALES AND PRODUCTION SCHEDULES

The Gantt progress chart in a variety of forms is in such common use in industry today that a description of its general form and operation is unnecessary. As used in this department (see Fig. 1) it portrays in the usual graphical form, based on horizontal bars, the following information:

1. The estimated sales, by major finished products, for each month of the fiscal year, cumulative to end of each month. This information is taken from the sales budget.
2. The estimated production schedule, by major finished products, for each month of the fiscal year, cumulative to the end of each month. This information is taken from the production budget.
3. The factory orders, by major finished products, that have been started to date.
4. The factory orders, by major finished products, that have been completed to date. The information for this item and the one immediately preceding is taken from the weekly production reports of the manufacturing divisions.
5. The sales to date, by major finished products.
6. The shipments to date, by major finished products. The information for these last two items is taken from reports prepared by the tabulating section of the sales department.

When the Gantt chart has been prepared as described above, an examination of it will reveal these facts:

1. Relation of actual and estimated sales.
2. Relation of actual and estimated production.
3. Relation of actual sales and actual production.
4. Relation of sales to shipments, perhaps revealing unfilled orders.
5. Relation of production and shipments, showing the amount of finished goods on hand.
6. Relation of factory orders started and those completed, showing the amount of work-in-process.

A study of the above conditions with reference to each of the major finished products constitutes a rather comprehensive survey of actual sales and production conditions.

It is apparent that with all of the above mentioned information in his possession, the head of the general inventory control department should be able to decide very intelligently with regard to purchase orders, production orders, and interdivisional orders that come to him for approval. For example, suppose that the order calls for the purchase or manufacture of raw material, parts, or minor assemblies. Reference to the tabulated information resulting from the preliminary analysis of the various products will show to what extent and in what products this particular material, part, or assembly is required; reference to the Gantt chart will reveal the present condition of production, sales, and shipments, both estimated and actual, of these products; the mere fact that the order is desired indicates that the inventory has fallen to a certain minimum, the "order point." A careful consideration and proper weighting of these facts indicates very clearly whether or not the order in question should be approved wholly or in part, or not at all.

If the proposed order should call for the manufacture or assembly of a certain number of completed units of product, the problem is even simpler, for only the Gantt chart need be used. The present relation of the estimated and actual sales, the estimated and actual production, actual production and actual sales or shipments of this particular unit of product is information enough to justify a decision as to whether or not additional units should be manufactured or assembled.

Control of Branch Inventory

Previous to the installation of the present system of inventory control, an order sent in to the factory by a branch manager was filled without much question, and the result was largely overstocked and very irregularly stocked branches. Also, much "dead" stock accumulated at many of the branches and very little attempt was made from year to year to move it. The loss on inventory in 1921 and 1922 has been mentioned, and it was partly the result of this loose system of control. It had been very difficult to maintain accurate stores records at the branch offices, and it was only at the end of the fiscal period, when the physical inventory was taken, that the true state of affairs would become known to the branch manager and to the home office executives. In connection with the general improvement of inventory control, a more accurate system of stores records was installed at the branch offices, but the most important feature of the new method of control was the placing in the hands of the head of the general inventory control department the supervision of all branch inventories, including the right of approval or disapproval of all shipments to branches for stock. This control is exercised by the method described below.

"Commodity Cards"

For each item of stock carried by the branches there is maintained in this department a "commodity card." This card contains a double column for each branch, one for the original stock on hand and additional orders, the other for transfers of stock to other branches or to the factory. No attempt is made to keep on this card a perpetual inventory of branch stock, for no entry is made for shipments from branches to customers. However, the card remains accurate enough for control purposes for two reasons: First, each branch sends periodically to the head of this department a complete inventory, and the commodity cards are corrected to the date of the inventory. Also, with each order for additional shipments of a particular commodity to a branch, there must be sent the present inventory of that commodity, and this figure, together with the amount of the shipment, is entered on the proper card. This makes possible quite a degree of effective control and it is thought that the greater degree of accuracy which could be secured by making of these commodity cards a perpetual inventory, i. e., by including the shipments from branches to customers, would not be sufficient to pay for the additional expense.

Checking Up Orders From Branches

The original inventory figure, with the date; the additional orders shipped, with the date of shipment; and the present inventory at the time an additional shipment is requested—all of these serve to give a very accurate idea of the activity of the particular item at each branch and sufficient indication as to whether or not the request for an additional shipment should be approved. For example, suppose that Branch A orders from the factory a certain amount of commodity X, including with the order a statement of their present inventory. Reference to the order and to the X "commodity card" will reveal this information to the head of the general inventory control department:

1. How much of commodity X was at Branch A at the date of the last inventory.
2. Dates and amounts of additional orders since the last inventory and the inventory at the time of those orders.
3. Dates and amounts of any transfers to other branches.
4. Present inventory at Branch A.
5. Apparent activity of commodity X at Branch A.
6. Most recent inventory figures of commodity X at other branches and its activity at those branches.

With this information before him, he can decide whether or not Branch A needs any of commodity X and, if so, whether to ship from the main factory or to transfer from some other branch. Of course, the transfers would be made as soon as possible after the new inventory is received from the branch, for the records lose something of their value for transferring because of shipments to customers. However, experience has shown that the periodic inventory figures and the figures submitted with each request for additional shipments maintain a degree of accuracy sufficient for control purposes. The net result of this method has been a material decrease in the total branch inventory,

and the complaints from branch managers have been surprisingly few.

In addition to the maintenance of a minimum inventory throughout the entire organization, the general inventory control department furnishes some service to other departments. From the information available from his records, the head of the department furnishes to the sales department a list of inactive items which may be used as the basis for a sales campagin to clear out "dead" stock. The results of the campaign are checked by asking the branches for a new inventory, these inactive items being given special prominence.

On the strength of his control of shipments, his knowledge of the activity of various items, and other information which he may secure relative to cost and profit, the head of the department makes recommendations as to products which should be dropped from the company's "line." Such recommendations are sent to the production manager and the assistant sales manager with reasons why such action is desirable, and their approval is sufficient to make the recommendation effective without any further delay.

The Engineer as an Executive

JULIUS KRUTTSCHNITT, Chairman of the Executive Committee, Southern Pacific Lines, in a recent address[1] presented a very comprehensive outline of the duties and problems confronting the engineer who is called to the responsible position of executive head of a railroad. The following quotations point out some of the requirements for success in such an office.

To judge correctly of the qualifications of a man for the position of railroad executive we must make a comprehensive survey of the duties devolving on him under present-day conditions, and of the difficulties which he has to overcome. . . .

To attain the maximum or even moderate success in creating a margin between the cost and sales prices of output, the necessary executive and administrative work can best be done by men specially trained in those branches of knowledge that contribute most to the efficient operation of railroads, on the degree of which depends success or failure; and the most important duty of the chief executive is so to select his official staff as to attain the best results. To pass intelligently on the qualifications of his staff and their recommendations that may reach him—in other words, to avoid being a mere rubber stamp to approve whatever is laid before him—requires a fair knowledge of the functions of each department head by the chief executive. . . .

At the end of the nineteenth century 35 cents net out of every dollar could be turned into the treasury, while at the present time only 24 cents, or 32 per cent less, can be turned in, and it requires the closest kind of management and the services of very much more highly trained executives to meet all money requirements other than mere operating expenses out of 24 cents out of every dollar. . . .

After supplying extensive data on economies which the railroads have brought about in all branches of operation, and telling something of their present endeavors along this line, Mr. Kruttschnitt, referring to a National Industrial Conference Board report, says:

Of the 41,600,000 persons who were gainfully employed in 1920, according to the United States census for that year, less than 4 per cent planned the activities and directed the energies of the whole working force. The same census figures show that since 1870 the number of administrators, supervisors, and technical experts has rapidly increased. In 1870 the number of persons engaged in administration and supervision was 170,000, or 1¼ per cent of those gainfully occupied. In 1890 the corresponding figure was 450,000, or 1.74 per cent and in 1920, 1,510,000, or 3.6 per cent.

An examination of the personal records of the chairmen and presidents of the railroads of the United States shows that in 1922, out of 32 chairmen, 11, or 34 per cent, had risen from the Engineering Department, and out of 171 presidents, 33, or 19 per cent, had risen from the ranks of engineers.

He then concludes:

Although a good technical expert may not develop into a good executive, nevertheless successful administrators should have certain characteristics, such as a good grasp of the fundamentals of science, the ability to think logically and quantitatively, exactness of method and power of analysis, the habit of looking forward, sound economic theories, an unlimited capacity to learn, pronounced firmness combined with a high sense of fairness and charity needed to control men, and the ability to write and speak clearly and correctly. . . .

In emphasizing the importance of training, we must studiously avoid withering the aspirations and stifling the ambition of the large numbers of men in railroad and industrial service who have not had the benefit of overmuch school or any college preparations. These men outnumber vastly the high school and college men, and to their credit be it said that the 65 per cent of chairmen and 81 per cent of presidents remaining after taking account of those that have risen from the ranks of engineers, have been drawn largely from the men who have had none of the benefits of higher education. . . .

Sympathetic guidance of both the college man and the non-college man presupposes a careful evaluation of the work of all employees and assurance to them that talent and effective work will be known to and appreciated by the management. Educators report a growing feeling among undergraduates that in most large corporations a young employee often is lost in a department, and for many months may not come under the observation of the leading men of the organization. A large public-utility company, the two largest manufacturers of electrical apparatus, and a few other large corporations which have unusual and enlightened personnel departments, in many cases are getting the pick of the young talent because of their attention to this problem.

These are some of the ways in which industry can supplement the work of the educators, and profiting by their example thus can we help those who are to "carry on" when we shall have passed.

[1] Address at a joint meeting, New York, March 18, 1925, of the New York Sections of the American Society of Civil Engineers, American Institute of Electrical Engineers, and American Institute of Mining and Metallurgical Engineers, the Metropolitan Section of the American Society of Mechanical Engineers, and the New York Electrical Society.

Financing Domestic Automobile Sales

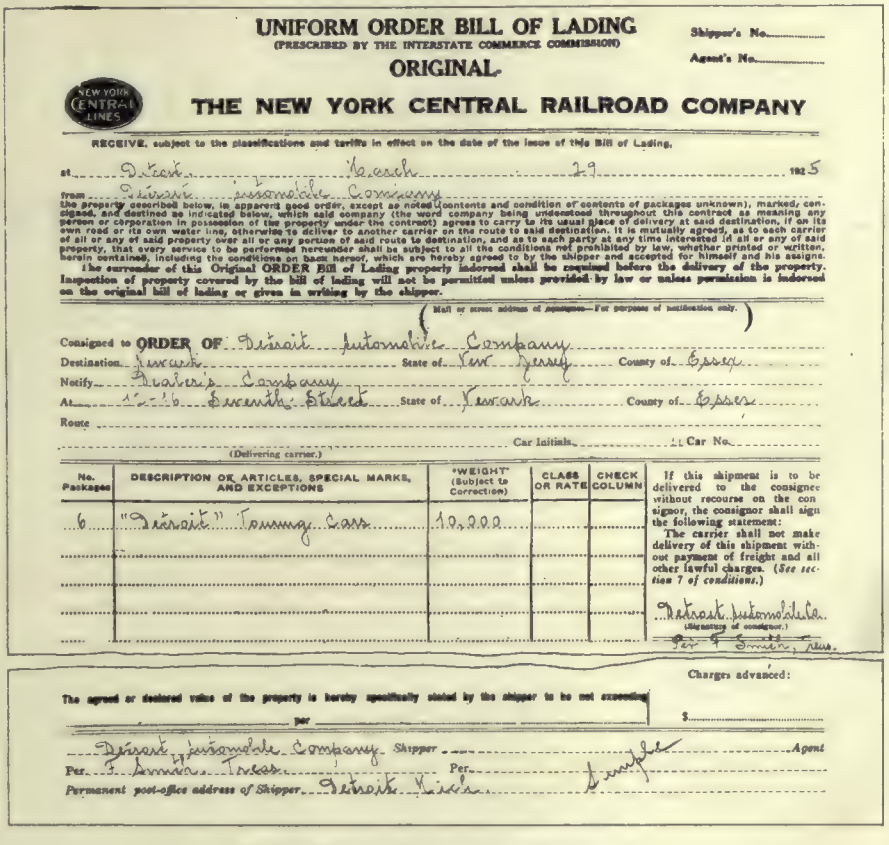
Manufacturer's Relation to This Special Marketing Service

By C. C. HANCH

General Manager, National Association of Automotive Financing Companies

FINANCING in the automobile industry has become recognized as a service distinct and apart from manufacturing or selling, and as such entitled to a fair remuneration whenever used. The attitude has prevailed that the most good can be accomplished when the manufacturer concentrates his efforts on improvements in production systems, when the dealer engages in extensive sales promotion and when financial institutions are so organized as to take care of whatever credit extensions arise in connection with the trade.

The recognition of financing as a service finds its justification in the fact that dealers or customers can buy motor vehicles for cash at definitely fixed prices. In such instances there is no need for any special financing service. On the other hand, if credit extensions are asked it is evident that special services are involved, and that customers desiring credit, and they only, should be called upon to pay for the facilities especially made available to them.



UNIFORM ORDER BILL OF LADING
(PRESCRIBED BY THE INTERSTATE COMMERCE COMMISSION)
ORIGINAL.

Shipper's No.
Agent's No.

THE NEW YORK CENTRAL RAILROAD COMPANY

RECEIVED, subject to the classifications and tariffs in effect on the date of the issue of this Bill of Lading,

at Detroit Mich. March 29 1925

from Detroit Automobile Company

the property described below, in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and destined as indicated below, which said company (the word company being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on its own road or its own water line, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the conditions not prohibited by law, whether printed or written, herein contained, including the conditions on back hereof, which are hereby agreed to by the shipper and accepted for himself and his assigns.

The surrender of this Original ORDER Bill of Lading properly indorsed shall be required before the delivery of the property. Inspection of property covered by the bill of lading will not be permitted unless provided by law or unless permission is indorsed on the original bill of lading or given in writing by the shipper.

(Mail or street address of consignee—For purposes of notification only.)

Consigned to ORDER OF Detroit Automobile Company

Destination Newark State of New Jersey County of Essex

Notify Dealers Company

At 176 Seventh Street State of Newark County of Essex

Route

(Delivering carrier.) Car Initials Car No.

No. Packages	DESCRIPTION OF ARTICLES, SPECIAL MARKS, AND EXCEPTIONS	"WEIGHT" (Subject to Correction)	CLASS OR RATE	CHECK COLUMN
6	"Detroit" Tommy Cars	10,200		

If this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement:
The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges. (*See section 7 of conditions.*)

Detroit Automobile
(Signature of consignor.)
Per E. Smith, Pres.

Charges advanced:

The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding
per $

Detroit Automobile Company Shipper Agent
Per E. Smith, Pres. Per

Permanent post-office address of Shipper Detroit, Mich.

FIG. 1 BILL OF LADING FOR SHIPMENTS

The final consideration of financing as a separate service was directly due to developments which arose in the automotive industry, but which are not generally found in other lines of endeavor. In the initial stages of the industry, the manufacture of automobiles was carried on by concerns with relatively small means. Their resources and credits in many instances were barely sufficient to finance production which required thousands of dollars.

In view of this stringency of capital, the manufacturers were compelled to limit their transactions to cash sales only. In many instances the dealers were even asked to put up deposits to show good faith, and were generally able to do this, as the public bought cars from them as fast as they were produced. Thus a commodity representing a very large value unit was actually sold against cash and continued to be sold on that basis for a considerable period of time.

Certain conditions, however, necessitated changes in conducting the business. The large sums involved began to restrict the operations of dealers. Furthermore, they were obliged to carry large quantities of cars in stock. This became particularly necessary as the automobile manufacturers had to operate their plants uniformly during the twelve months of the year, even though the public buying season was limited to the summer. Continuous uniform production is the very essence of efficient operation and economical cost. Accordingly, dealers were expected to divide annual requirements into 12 parts and to take monthly shipments from the factory on the basis of that schedule. This meant that the dealers had to carry substantial stocks of cars in the winter and be ready to take care of the big spring and summer demand which could not be supplied by the manufacturer if production were curtailed in the winter. Many dealers and distributors consequently felt the urgent need of financing their winter stock of cars.

The importance of financing as a distinct service to the automobile trade became evident, also, as more

and more requests were received from prospective buyers for more favorable terms than were accorded in cash transactions. The manufacturers, because of their own need of cash in carrying on operations on a large scale, were unable to relieve these financial strains to the extent required for the good of the business.

$1220 [illegible] April 8 1925

At Sight Pay to the

Order of Manufacturer's Bank

Twelve Hundred twenty [illegible] Dollars

Value received, and charge the same to account of

To Dealer Company | Detroit Automobile Co

No Newark, N.J. | F. Smith Pres.

FIG. 2 SIGHT DRAFT DRAWN UPON DEALER

Due to these peculiar conditions, there were gradually devised plans for financing wholesale and retail automotive trade. The purposes of these plans are to lessen the burdens incidental to the shipping of automobiles from the factory to the dealer, or to make purchases by individuals more easily possible through the accordance of credit terms. Financing figures prominently from the time that the car leaves the factory until it is placed in possession of the final buyer.

Various practices will be found in the financing of wholesale trade. Usually the manufacturer will have a "to order" bill of lading prepared. (See Fig. 1.) This document will indicate the name of the dealer to be notified upon arrival of the shipment at destination. As the bill of lading is made out to the order of the manufacturer it serves as definite title to the shipment until endorsement on it is made by the manufacturer and the draft accompanying it has been taken care of by the dealer, who to that end gets in touch with the bank of the manufacturer, or its correspondent bank in the city of the dealer. The draft accompanying the bill of lading, a sample of which is shown in Fig. 2, is usually at sight and has to be taken up by the dealer immediately upon notification by the manufacturer's bank.

As soon as the dealer has paid the draft he becomes entitled to the bill of lading and consequently is owner of the car. If these are cars that he intends to stock and for which he has no particular need at the moment, he may give up the bill of lading to a warehousing concern, which will have the automobile transported from the railway siding to its bonded warehouses and issue to the dealer a separate negotiable receipt, as shown in Fig. 3, for each automobile taken in. This receipt can be sold to anyone and entitles the bearer to secure possession of the car from the warehouse. No legal action can be brought against the warehousing firm in the event that these receipts are stolen and possession of cars represented by them are fraudulently acquired by others than the owners. Due to the negotiableness of this receipt, the dealer or anyone also possessing it, may take it to the bank and borrow on it to the extent of one-half of the selling price of the car. This arrangement is particularly favorable to the dealer, as it enables him to avoid any extensive tie-up of his capital in stock of cars and to reduce limitations on use of liquid assets in other parts of the business.

It may also happen that the inland bank of the manufacturer authorizes its correspondent bank to lend the bill of lading to the warehouse company, which in that way can take the automobiles from the railway station, place them in storage, and furnish the bank with negotiable warehouse receipts for the automobiles included in the shipment. Under this method the dealer can take up the automobiles one at a time by arranging for the payment of the warehouse receipts which are held as titles to the vehicles by the bank on behalf of the manufacturer. The dealer naturally will take up these titles more rapidly during periods of good business.

Considerable wholesale financing is also done through the medium of automotive finance companies. Usually

WAREHOUSE RECEIPT

Sample

New York, 19

P. BRADY & SON CO.

552-554 556 WEST 58th STREET

has received for the account of Dealer's Company

Marks One Touring Car - Make "Detroit"

Number 48642

Ex. ..... Del'd here by ..... J. C. Brown

upon the following terms and conditions:

Goods stored at owner's risk of damage by moth, rust, fire, heat, cold cracking of varnish or leather or depreciation by time.

Packages with contents invisible will be received as "contents unknown" and we will not be responsible for the condition of the contents of same.

One month's storage will be charged for any fraction of the first month after the first month, a half month's storage will be charged for any fraction of a half month.

A charge for labor will be made when so agreed. It being understood and agreed that the storage charges thereon, shall be paid before the said article is released from our warehouse, and that the said article shall not be released or delivered to any party until the surrender of this original receipt and that the surrender of this original receipt and payment of charges shall entitle any party so surrendering the same to receive the said article and remove the same from our warehouse when all liability upon the undersigned shall cease. It being agreed by the undersigned that until the surrender of this original receipt the said article will be kept in its warehouse.

This contract contingent upon strikes, fire, accident or any other cause beyond our control.

NEGOTIABLE

Rate ..... ✓ .....

P. BRADY & SON CO.

By Wm Barton

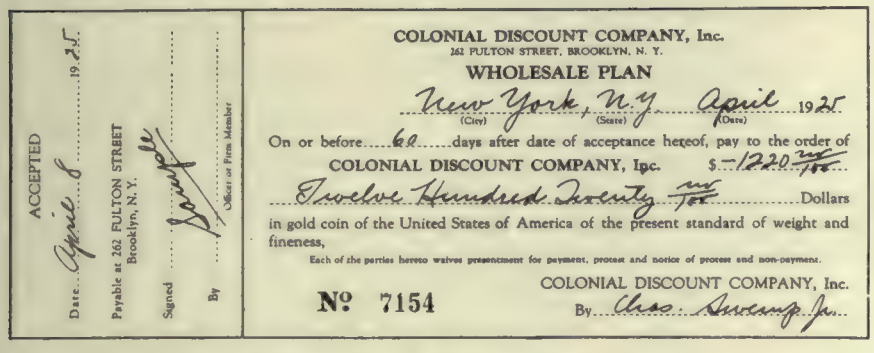
FIG. 3 NEGOTIABLE WAREHOUSE RECEIPT

definite arrangements are made between the dealer and the financing company before the orders are placed with the manufacturer. Stipulation is also made by the financing company that from 15 to 20 per cent of the invoice price, plus freight charges, be deposited by the dealer with the finance company. The finance company then proceeds to make out a check for the whole amount involved in the shipment. This check, which may be certified if so required, is presented to the bank holding the bill of lading on behalf of the manufacturer. This document, giving title to the motor vehicles, is endorsed by the finance company

over to the dealer who, however, in turn is called upon to sign an acceptance or time draft. (See Fig. 4.)

Usually, drafts drawn early in the season, that is, in November or December, are for six months. January drafts are for five months, February drafts are for four months, and drafts drawn from March to October are usually for three months. The object sought is to make the terms of the draft sufficiently long to enable the dealers to sell the cars before they mature.

As already indicated, financing is considered as a distinct service to be paid for. Accordingly, dealers



ACCEPTED
Date April 6 1925
Payable at 262 FULTON STREET Brooklyn, N.Y.
Signed Sample
By
Officer or Firm Member

COLONIAL DISCOUNT COMPANY, Inc.
162 FULTON STREET, BROOKLYN, N. Y.
WHOLESALE PLAN

New York, N.Y. April 1925
(City) (State) (Date)

On or before 60 days after date of acceptance hereof, pay to the order of
COLONIAL DISCOUNT COMPANY, Inc. $ 1220 00/100
Twelve Hundred Twenty 00/100 Dollars
in gold coin of the United States of America of the present standard of weight and fineness,
Each of the parties hereto waives presentment for payment, protest and notice of protest and non-payment.

No 7154

COLONIAL DISCOUNT COMPANY, Inc.
By Chas. Sweeney Jr.

FIG. 4 DEALER'S ACCEPTANCE OR TIME DRAFT

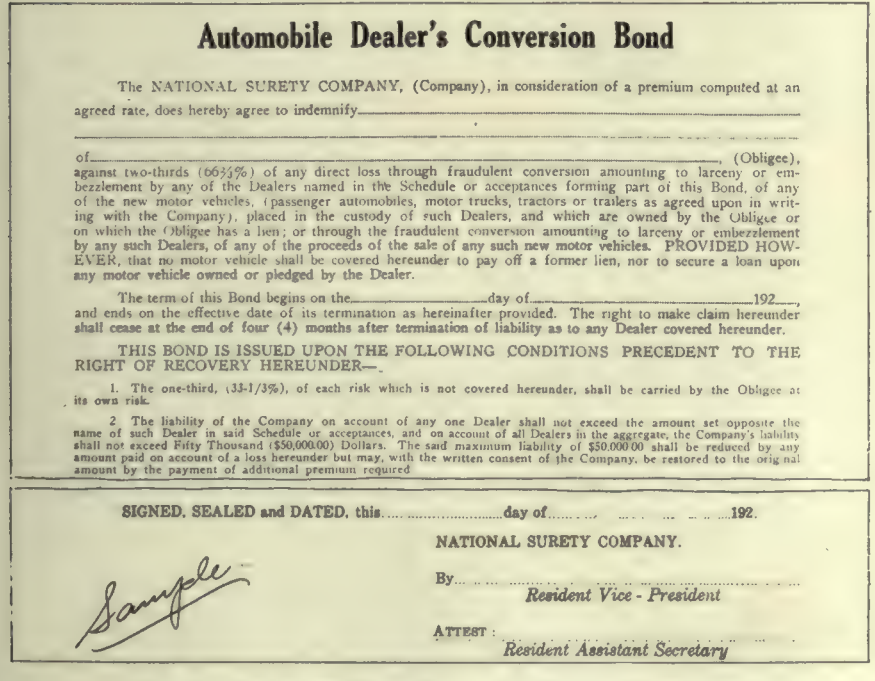
are charged a stated amount, usually 2 per cent for the first month and 1 per cent for each succeeding month, of the invoice price plus freight. These charges cover interest, cost of fire and theft insurance, and cost of a conversion bond (see Fig. 5) protecting the financing company against fraudulent disposal of the cars by the dealer. If the cars are sold before maturity of the loan, the service charges are rebated on a pro-rata basis after the end of the first month.

The conversion bond is mostly used when the automobiles are not placed in a bonded warehouse but are rather put on the floor of the showroom of the dealer. In such instances the financing company is dependent solely on the integrity of the dealer and consequently must rely on the conversion bond for its protection. By it the dealer is definitely obligated to pay the finance company the amount involved in a sale before removal of the cars from the dealer's establishment. Failure on the part of the dealer to live up to this part of the agreement subjects him to legal prosecution by the surety company which issues the bond in favor of the finance company. Under the conversion bond the surety company is not liable for failure of the dealer to meet his draft, but is obliged only to see that payment is made to the finance company or that instead the automobile is available to it.

To retain title to the car while it is still unpaid for and while practically lent to the dealer for display in his establishment, the finance company may ask the dealer to sign a document indicating that the automobile is to remain the property of the finance company until all claims on it have been paid. Some companies purchase the cars to secure legal title and then give the dealer a re-purchase option. In some instances a trust receipt (see Fig. 6) is employed to accomplish the same object. It is usually stipulated that the cars subject to these agreements cannot be used even for demonstration purposes.

The above procedure is nearly identically followed in cases where a distributor or direct dealer makes shipments to a sub-dealer, except that the documents are prepared and forwarded by the distributor or direct dealer, instead of the manufacturer, and they are executed and paid by the sub-dealer instead of by the direct dealer or distributor. The advantages to the dealer of these plans of financing are that they enlarge his credit, prevent him from leaning too heavily upon his local bank and assure a stock of cars at all times. In certain instances dealers finance their stock of cars with their own resources and credits.

Under the plans indicated so far, the responsibility of the manufacturer actually ceases the moment that the bill of lading is taken up and payment has been made. In view of the large loans involved, some finance companies have sought the assistance of manufacturers upon definite terms and conditions of co-operation which would enable the financing institutions to re-discount loans of banks and thus expand the use of capital. In fact, agreements have been made with this in view, whereby manufacturers re-purchase from the finance



Automobile Dealer's Conversion Bond

The NATIONAL SURETY COMPANY, (Company), in consideration of a premium computed at an agreed rate, does hereby agree to indemnify

of (Obligee), against two-thirds (66⅔%) of any direct loss through fraudulent conversion amounting to larceny or embezzlement by any of the Dealers named in the Schedule or acceptances forming part of this Bond, of any of the new motor vehicles, (passenger automobiles, motor trucks, tractors or trailers as agreed upon in writing with the Company), placed in the custody of such Dealers, and which are owned by the Obligee or on which the Obligee has a lien; or through the fraudulent conversion amounting to larceny or embezzlement by any such Dealers, of any of the proceeds of the sale of any such new motor vehicles. PROVIDED HOWEVER, that no motor vehicle shall be covered hereunder to pay off a former lien, nor to secure a loan upon any motor vehicle owned or pledged by the Dealer.

The term of this Bond begins on the day of 192, and ends on the effective date of its termination as hereinafter provided. The right to make claim hereunder shall cease at the end of four (4) months after termination of liability as to any Dealer covered hereunder.

THIS BOND IS ISSUED UPON THE FOLLOWING CONDITIONS PRECEDENT TO THE RIGHT OF RECOVERY HEREUNDER—

1. The one-third, (33-1/3%), of each risk which is not covered hereunder, shall be carried by the Obligee at its own risk.

2. The liability of the Company on account of any one Dealer shall not exceed the amount set opposite the name of such Dealer in said Schedule or acceptances, and on account of all Dealers in the aggregate, the Company's liability shall not exceed Fifty Thousand ($50,000.00) Dollars. The said maximum liability of $50,000.00 shall be reduced by any amount paid on account of a loss hereunder but may, with the written consent of the Company, be restored to the original amount by the payment of additional premium required.

SIGNED, SEALED and DATED, this day of 192.

NATIONAL SURETY COMPANY.

Sample

By
Resident Vice-President

ATTEST:
Resident Assistant Secretary

FIG. 5 CONVERSION BOND ISSUED BY SURETY COMPANY

TRUST RECEIPT **No. 7154**

City New York State N.Y. Date April 8 192.5

Received from COLONIAL DISCOUNT CO. INC., the owner thereof (hereinafter called Colonial),

"Detroit" Motor Vehicle, Model Sedan, Serial No. M7249, Motor No. M3215,

complete with all standard attachments and equipments.

In consideration thereof, we, the undersigned, agree to hold said Motor Vehicle in trust, as the property of Colonial, for the purpose of storing same free of charge, and will return it on demand, prior to sale as hereinafter authorized, in good order and unused, it being understood that we have no right to, and will not operate or use said Motor Vehicle for any purpose, nor loan, rent, mortgage, pledge, encumber, sell or deliver the same except as authorized herein; nor warehouse the same except for the account of Colonial, and in such event the warehouse receipt therefor shall be taken in the name of Colonial; but we shall have the liberty to sell said Motor Vehicle for cash, and in an amount not less than the sum due on an acceptance, accepted by us and held by Colonial, of even date and number, the intention being to preserve unimpaired Colonial's title to said Motor Vehicle, until the full payment of said obligation, the acceptance of which shall not be effective to terminate this trust; and in the event such property shall be sold, as provided herein, we shall hold the proceeds of such sale separate from our funds, and immediately hand over and deliver such proceeds, or sufficient thereof to satisfy said acceptance, to Colonial.

It is also agreed that Colonial may at any time cancel this trust, repossess itself of the said Motor Vehicle, and sell the same at public or private sale without notice to us, at Colonial's absolute discretion; that in the event of the institution of proceedings in bankruptcy by or against us, or an assignment for the benefit of creditors on our part, or our suspension or our failure to pay any of our indebtedness or obligations whatsoever to Colonial, including the said acceptance, or any breach of this trust, then all our acceptances, obligations, indebtedness and liabilities whatsoever due to Colonial, shall thereupon, with or without notice to us, at the option of Colonial, mature and become payable immediately.

We further agree to keep a separate account of all Motor Vehicles delivered to us under this or any like receipt, and of the proceeds thereof when sold, and to report any sale to Colonial immediately after the same is made; to permit Colonial or its representatives to examine our books and all motor vehicles in our possession during business hours; that we will, during the entire time the said Motor Vehicle is held hereunder, keep the same insured against loss by fire and theft, at our own expense, and deliver the policies therefor to Colonial, and cause a surety bond for the accounting for said Motor Vehicle or the proceeds thereof to be issued, at our own expense and delivered to Colonial; and in the event of our failure to redeliver the said Motor Vehicle to Colonial on demand, we shall, until redelivery thereof, pay as damages for detention, for each month or portion thereof after such demand, one percent of said sale price.

We also agree that we will pay all costs, charges, expenses, and disbursements, including a reasonable attorney's fee (15% of such sale price of said Motor Vehicle if permitted by law) should Colonial find it necessary to protect its property by legal proceedings involving the employment of an attorney at law, and should Colonial exercise its rights of repossession or of sale of said Motor Vehicle, we shall continue to be liable to and shall pay Colonial, any indebtedness arising hereunder or under the said acceptance, less the proceeds of sale by Colonial, if any; that the waiver of any default shall not operate as a waiver of subsequent defaults, but that all rights of the Colonial hereunder shall continue notwithstanding any one or more waivers; that this agreement and all the terms and conditions thereof shall enure to the benefit of the Colonial, its successors and assigns, shall be construed according to the laws of the State of New York, and shall not be altered, modified or varied, except by written instrument signed by an officer of Colonial.

Witness M. Hastings Sample

Signed J. J. Humphrey Trustee-Bailee

By P. J. McMullen Officer or Firm Member

FIG. 6 BANKER'S TRUST RECEIPT

companies any new cars they might have to take back from dealers, due to miscellaneous causes. Re-purchase agreements of this kind, a sample of which is shown in Fig. 7, are usually made in instances where the manufacturer maintains his own selling branches, as is frequently done by firms making motor trucks. These branches are frequently firms that are separately incorporated under the laws of the state in which they operate, but with the majority of the stock owned by the manufacturers. In such instances re-purchase agreements are frequently made to extend to the manufacturer and not solely to the branch company. In some cases, however, finance companies have been satisfied with a re-purchase agreement with the branch firm and in the carrying out of which the parent company was not obligated.

The widest use of re-purchase agreements, however, is made in connection with retail sales and principally involves the finance company and the dealer. It consists simply of an assurance by the dealer that he will help the finance company in the disposal of any cars which the finance company may have to re-possess because of the failure of a customer to complete payment. Resort to the re-purchase agreement need not very frequently be made by the finance companies, as it has been estimated, according to results of a survey published in the Federal Reserve Bulletin, that re-possessions are in most cases less than 1 per cent of total credit sales.

In the financing of retail sales, the dealer is afforded by finance companies policies that may require the dealer's endorsement, or be limited to a re-purchase agreement, or exempt him from all liability. The fees charged by the finance companies, of course, will vary with the type of service offered.

Plans are also offered for putting the dealer in a position to finance sales through his local bank by means of a surety company bond guaranteeing the payment of the notes to the bank. This bond removes all question on the part of the bank as to the security of the collateral. The bank does not even have to concern itself as to whether or not the lien instrument is valid, or whether the vehicle has been insured, or about the responsibility of the maker or endorser, as the bond is an absolute guarantee to pay if the maker

Automobile Discount Co., Inc.,
200 Fulton Street,
Brooklyn, N. Y.

Dear Sirs:

In consideration of your discounting for us from time to time acceptable instalment notes of purchasers to whom we have sold automobiles on deferred payments and secured by chattel mortgage, conditional sales contracts, or leases, such notes being discounted by you for us endorsed "without recourse"—we agree that, if you are obliged to repossess any such automobiles for non-payment of any instalments, or because of any default on the part of the purchaser, we will assist you to obtain possession of such automobiles and we will purchase such repossessed automobiles from you at the place of repossession for the amount of the unpaid balance on the note or notes held by you.

Yours very truly,
DEALER'S AUTOMOBILE CO.
per J. Long.

FIG. 7 FORM OF RE-PURCHASE AGREEMENT

No..... DO NOT MAKE ANY CORRECTIONS OR ERASURES IN NOTE AS TO DO SO MAY REQUIRE IT TO BE REWRITTEN

NOTE

$..... At.....192..
Town or City *Month* *Day* *Year*

The undersigned, promise to pay to the order of

.....
Dealer's Name

.....Dollars
in Gold Coin of the United States of America of the present standard weight and fineness, at COLONIAL DISCOUNT CO., Inc., 262 Fulton Street, Brooklyn, N. Y., in.....
Number of Months

equal monthly payments of $.....after the above date. Value received. And upon default in the payment of any installment when due, the whole amount remaining unpaid shall immediately become due, and if not paid shall bear interest six per cent. per annum thereafter, and the maker will also pay all costs of collection.

The undersigned hereby expressly waives any and all rights which he now has, or hereafter may have, under the Federal Statute known as "The Soldiers and Sailors Civil Relief Act" and any local statute of similar effect or purpose.

PLACE REVENUE STAMPS HERE 1 CENTS FOR EACH $100.00 OR FRACTION THEREOF

Partnerships sign firm name by partner signing. Corporations sign corporate name by Officer signing who must be authorized to sign checks.

.....
The buyer signs his name here

By .....

Buyer's Address .....

(Dealer endorses on back) .....

FIG. 8 CUSTOMER'S NOTE FOR TIME PAYMENTS

and endorser fail to do so. In order to secure such a bond the dealer purchases from his bank a certificate of deposit payable to the surety company for 10 per cent of the amount of the notes, and this certificate of deposit acts as a compensating balance to the bank for the loan and also a collateral to the surety company. The cost is 2 per cent per annum on the amount of the notes, which includes a coverage protecting the dealer against conversion of the vehicle by the purchaser. Where the dealer prefers to send the paper to the finance company for discount rather than handle it through his local bank there is an additional charge of 1 per cent per annum on the amount of the notes, making the total charge, if thus discounted, 3 per cent. Quite an inclination is found on the part of the dealers to send their paper to the finance company rather than discount it through their local banks. This is partially due to the fact that they follow the line of least resistance, and also because they have, in some cases, direct loans with the bank and feel that this would be asking for additional accommodation. The banks should consider this paper separate and apart from their regular loans to the dealers, for they are really buying securities at a rate of interest which they are unable to obtain on other paper of equal value.

In retail financing, an initial deposit is also required, ranging from about 25 to 40 per cent. The payment of this advance is most commonly spread over a period of from six to twelve months. (See Fig. 8.) Instalments usually fall due monthly and the charges of the finance company are added to the selling price

NEW JERSEY

ORIGINAL

Conditional Sale Agreement

This Agreement made this.....day of....., 19...., between

.....of.....
(Dealer's Name) (Dealer's Address)

first party, his or its successors, or assigns (hereinafter called "Seller"), and.....
(Buyer's Name)

at ..... in .....second party (hereinafter called "Buyer")
(Buyer's Street Address) Buyer's Town and State)

1. WITNESSETH:—THAT the Seller in consideration of the payments, agreements and conditions contained herein which on the part of the Buyer are to be made, done and performed, has this day delivered and agreed to sell and the Buyer has this day agreed to buy from the seller, but upon the conditions hereinafter recited, to the Buyer the following Passenger or Commercial Car, or Tractor (hereinafter called the "Car")

MAKE	Type of Body	Model Letter or Number	Manufacturer's Serial No.	Motor No.	No. Cylinders	Advertised Horse Pow.

If Truck Tons Capacity	Year Model	List Price	Selling Price

with extra equipment, for the sum of.....Dollars ($.....),
(Total Cost to Buyer)

The Buyer has this day paid to the Seller.....Dollars ($.....),
(Total Payment Made)

and the Buyer agrees to pay the Seller, or order.....Dollars ($.....),
(Total Balance to Be Paid)
balance, in instalments as follows:

$.....One month after date $.....Five months after date $.....Nine months after date
$.....Two months after date $.....Six months after date $.....Ten months after date
$.....Three months after date $.....Seven months after date $.....Eleven months after date
$.....Four months after date $.....Eight months after date $.....Twelve months after date

which instalments shall bear interest from maturity until paid at the highest legal contract rate and are to be evidenced by a promissory note (not as payment, but as evidence of the amounts to become due hereunder) made by the Buyer to the order of the Seller, bearing date hereof, and maturing on the due dates of said respective instalments. Any extensions or assignments of this Agreement or said note shall not waive any condition herein contained.

2. Title to the Car and extra equipment shall not pass by delivery to the Buyer but shall remain vested in and be the property of the Seller or Assigns until the purchase price has been fully paid. Buyer agrees to operate and control said Car in conformity with all Laws and Ordinances and to indemnify and save harmless the Seller from any and all loss, or damage to persons or property caused by said Car or by the use and operation thereof to which the Seller might possibly be subjected.

The buyer at all times agrees to store this motor vehicle at.....and therefore changing the location to notify the Seller, and receive written permission to move the motor vehicle.

10. IN WITNESS WHEREOF, the parties hereto have set their hands and affixed their seals to this Agreement, in duplicate, the day and year first above written.

Witness: ..... (Seal)
(Buyer Sign Here)

Address:.....

Partnerships must sign firm name by partner signing. Corporations must sign corporate name by officer signing and must affix the corporate seal and in all cases the signature must be witnessed.

By ..... (Seal)
(Owner, Officer or Firm Member)

Witness: ..... (Seal)
(Dealer Sign Here)

Address:.....

By ..... (Seal)
(Owner, Officer or Firm Member)

DEALER MUST SIGN ASSIGNMENTS ON REVERSE SIDE

FIG. 9 TYPICAL CONDITIONAL SALES AGREEMENT

of the car, as a basis for computing the percentages.

In retail financing, it is evident that the security is in actual use and consequently subject to various contingencies. Insurance is resorted to to provide against them. Protection against depreciation is also secured by the margin between the value of the car and the increase in instalment payments.

To maintain title in the case of a retail sale the finance company may employ a lease agreement, a chattel mortgage, or conditioned bill of sale (see Fig. 9). The last-named document is most frequently used in states where a conditional sales act has been passed and which is of a uniform character in most states of the Union. The actual form used, of course, will depend on the preference of the finance company. Even actual wording of these contracts will vary.

Few manufacturers actually get into direct financing of the retail sales of their products. The General Motors Corporation is an exception and maintains its own subsidiary to take care of the retail and wholesale financing of products of that concern. Even in this instance the financing institution is looked upon as a unit separate and apart from the others that have to do with manufacturing.

The General Motors Acceptance Corporation is viewed practically as a self-supporting unit, entitled to fees for the services it performs. How extensive these services have been may be gleaned from the statement made by its president, Curtis C. Cooper, that over one-half billion dollars' worth of automotive financing was done during the year 1923. At the same time it was pointed out that $229,000,000 of this amount was devoted to the wholesale transactions and $272,000,000 to the retail end.

Other companies among the automobile manufacturers make arrangements for the handling of their financing by one institution. The Studebaker Corporation has a very close working arrangement of this kind. Other manufacturers arrange to help in the wholesale financing but avoid any extensive efforts in the financing of retail sales. Some companies will even ship to their dealers against time draft, but charge for this extra service at a reasonable interest rate, and also add a fee for the actual accommodation.

In nearly all instances, it will be found, however, that financing is a separate service for which a charge can justly be made whether the facility is afforded by finance company, bank, or manufacturer.

Recent Progress in Standardization*

A TENTATIVE draft of the cotton mill section of the Safety Code for Textiles is now being circulated for criticism. Sections on woolen, silk, worsted, and dyeing and finishing processes are yet to be drafted. The National Safety Council and the National Association of Mutual Casualty Companies are joint sponsors for the project. The Code is divided into four main sections: the first dealing with scope, purpose, definitions, general applications, mill layout, and power; the second, with specific machines and items of plant equipment; the third, operating rules; and the fourth, a general discussion of the Code.

The Sectional Committtee on the Standardization of Pipe Flanges and Fittings has approved, by a practically unanimous vote, for submission to the sponsor organizations, a number of important standards applying to malleable iron screwed fittings, and cast iron.

For malleable iron screwed fittings, 150 lb. per sq. in. working steam pressure.
- Crosses, tees, 90 and 45 deg. ells, straight and reducing, street ells 90 and 45 deg., and service tees, straight and reducing.
- Caps
- 45 deg. Y's, straight and reducing
- Couplings
- Open pattern return bends
- Medium pattern return bends
- Close pattern return bends

For cast-iron screwed fittings, 125 and 250 lb. per sq. in. working steam pressure
- Crosses, tees, 90 and 45 deg. ells, straight and reducing.

The American petroleum Institute has just issued two standards, as follows: No. 3-1924, "Dimensional Standards of Cable Drilling Tool Joints"; and No. 5-1924, "Specifications for Steel and Iron Pipe for Oil Country Tubular Goods." No. 3 includes a detailed dimensional standardization of the tool joints, including the questions of tolerances, basic thread form, pitch and taper of thread, recommended practice in turning of threads, marking of joints, and gaging. No. 5 covers lapwelded and seamless steel and iron tubular goods for oil country purposes; covering line, drill, and drive pipe, casing and tubing, including specifications on method of manufacture, chemical properties and tests, physical properties and tests, standard weights and variations therefrom, workmanship and finish, methods of gaging and tolerances on gages with reference to the American Standard pipe thread; inspection, and rejection.

The De La Vergne Machine Company has developed a standard for slotted nuts for use with split pins, the existing castellated nuts being too small for the purpose, and not providing a sufficient number of slots for fine adjustment. The nuts as developed by the De La Vergne Machine Company provide a minimum adjustment of 0.005 to 0.008 in., studs having two holes drilled at 90, 67.5, or 60 deg., according to the diameter.

The Standards Division of the Crompton and Knowles Loom Works has prepared in blueprint form a set of standard sheets dealing with tapers; bolt, nut, screw and washer proportions, including wood screws and lag screws; cotter pins and taper pins; reamers for taper pins and Morse tapers; standard lettering and cross section conventions; Woodruff keys; and other items.

* From Sustaining-Membership Bulletin No. 9 issued by the American Engineering Standards Committee, March 24, 1925.

Safety Nozzle for Gasoline Lines

AN ever-present danger in transferring gasoline to steel containers through a hose is that static or a spark from the nozzle may ignite the gasoline. This danger has been practically eliminated in the activities of the Associated Oil Company by the use of special nozzles like the one illustrated.

This nozzle is made of copper which is so soft that

FIG. 1 SAFETY NOZZLE FOR GASOLINE LINES

a spark is impossible, should it happen to strike the steel container while being inserted or removed from the opening. In addition, the nozzle is fitted with a spring catch which holds the nozzle tight against the opening. This device permits the operator to attend

FIG. 2 THE SPRING CATCH HOLDS THE NOZZLE WITHIN THE FILLING OPENING

to other duties while the container is being emptied, with no fear that the nozzle will fall out and gasoline be wasted. When the container has been filled, or when it is desired to remove the nozzle, pressure on the catch shown in the illustration releases the spring and frees the nozzle.

A Mirror Helps Elevator Traffic

IT is not always convenient to make the elevators face toward the main entrance. The best place to have a passenger elevator in a factory or factory office may be facing toward the interior corridor where people can reach it quickly. But many people come in from outside, including messengers with express or other packages which should be speedily delivered, and they should get the same service as the people from the interior of the building.

A mirror helps the elevator man in the engineering building of the Eastman Kodak Company to give everybody good service. The mirror is on the wall across from the corner of the elevator shaft, and facing the elevator; it also faces the flight of steps at the side of the elevator shaft, leading to out-of-doors. Before the elevator man clangs his gate shut and goes up, he always looks in the mirror to see whether anyone is coming up the steps or through the outside door. Often he picks up an extra passenger by a delay of only a second. Without the mirror the latest comer would have to wait until the elevator came down again, or he would have to shout through the corridor; or the elevator driver would have to come out of the elevator and look around the corner to make sure that he was not leaving anybody behind. So the mirror adds speed to elevator traffic as well as speed to individuals.

Package Passes

WHEN plants got so big, especially during the war, that the managers could no longer be personally acquainted with the new employees or even all the old employees, the same methods had to be inaugurated for dealing with employees as for dealing with the public. During the war, many companies were engaged in government business which partook of a semi-military character and which showed the importance of checking everything that went out of the factory, including not only the persons but the packages. Some

Call for package at office after registering. Present this ticket.

HAWK-EYE WORKS
EASTMAN KODAK COMPANY 1055

PACKAGE PASS

NAME .....

No. ..... DATE .....

Own Goods ☐ Purchase ☐ Borrowed Goods ☐

Signed .....

PACKAGE PASS

of the lessons learned during that period will be permanently adopted. Plants handling valuable material may be especially interested in a method in the Eastman Kodak Company's Hawk-Eye plant, which manufactures small but valuable lenses. A pass is necessary for each package that goes out of the factory.

This pass is quite simple and the routine of using it interferes so little with the employees that nobody has any objection to it. Everybody realizes the advisability of it.

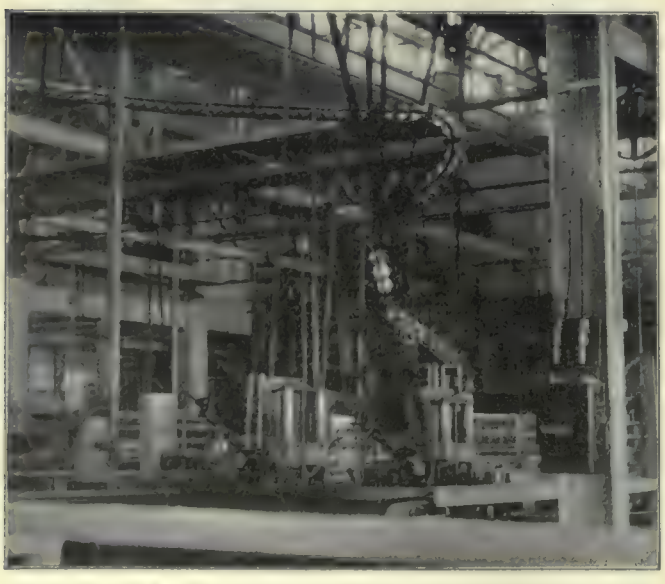
When an employee wishes to take a package out of the building, even if it is one that he has brought in with him in the morning, he goes to his foreman, who makes out a package pass in duplicate. The duplicate is pasted upon the package by the foreman. The original copy is surrendered to the gateman when leaving the plant before closing time. When the employee reaches the gate the pass on the package is compared with the original copy held by the gateman and the gateman thus has authority to pass the package and the employee. The passes are numbered serially, and the serial number on the package must agree with the number on the gateman's copy.

The pass specifies the name of the employee and his pay-roll number. Three little empty rectangles are provided, one of them to be filled with a check-mark certifying whether the package contains the employee's own goods, or goods just purchased from the company, or goods borrowed from the company, such as tools or other material. The foreman signs his name to the pass and is responsible.

Conveying in a Cannery

TO handle empty cans, taking them from cars to storage and from storage to filling machine, a cannery operated by Libby, McNeil & Libby uses a combination of electrical conveyors extending down the aisle of the can-storage room, to the receiving platform and to the canning machines.

Incoming cars are unloaded directly onto the conveyors and either are diverted to storage bins during their passage through the storage room or are taken directly through the canning operations. Four portable, self-contained electric elevators are used to feed the main conveyor system with cans from storage. Conveyors in the cannery are located at a considerable height above the floor, as shown in the illustration, so that cans are delivered to the filling machines by gravity.



EMPTY CANS ARE DELIVERED TO FILLING MACHINE BY GRAVITY

Handling Freight with Electric Trucks

ON the docks of the Bay Cities Transportation Company all freight was formerly handled by men equipped with 2-wheel dock trucks. Recently they replaced this method with a system using platforms and electric lift trucks.

Between 200 and 300 platforms are located on the various docks and all incoming freight is placed on them. The freight is not removed until the platform with its load has been picked up by an electric truck and deposited on the barge, carried to its destination, unloaded by another truck, and placed in position for delivery to the consignee's auto truck or dray.

FIG. 1 LOADED TRACTORS READY TO RUN UP INCLINE TO DOCK

Since practically all handling of the freight itself has been eliminated by this method, damage and loss claims have been materially reduced. Comparative figures show that one man with an electric truck can unload or load a barge of freight, consisting of approximately 100 tons, in 1½ to 2 hr. With the former method of hand trucking, it required the labor of 6 men for 4 or 5 hr. to accomplish the same result. Obviously labor costs have been greatly reduced, and, at the same time, delivery times have been reduced considerably.

FIG. 2 LOADED TRACTORS BEING REMOVED FROM BARGE

Reducing Oil Tank Fire Hazard

A VERY simple installation has been made on the oil tanks of S. T. Johnson Company which has greatly reduced the fire hazard always present when inflammable material is stored in quantities. At the highest point on each tank, which is at the center, an

REVOLVING SPRINKLER ON TOP OF OIL TANK

ordinary revolving lawn sprinkler has been installed and connected to the plant water supply line.

In operation this simple device keeps the roofs of the tanks constantly wet. Besides reducing fire risk, evaporation of the water lowers the temperature of the tank and its contents and so reduces, to some extent, vaporization losses of the gasoline, distillates, fuel oil, or whatever the contents may be.

Specifications for Forged Bolts

IN the manufacture of forged bolts, three finishes are available, plain forged, semi-finished, and finished. The first type is shipped ready for use after the forging, pointing, and threading operations. The other two types are given a final finishing or machining operation which makes the barrel, head, and neck dimensions conform to much closer dimension tolerances than is possible with plain forged bolts.

Manufacturing tolerances for plain forged bolts vary with the size of bolt, but 0.005 in. plus or minus is a fair average. For many uses this small variation would not affect the usefulness of the bolt, but for many others the buyers' ignorance of this tolerance might prove costly.

Plain forged $\frac{5}{8}$ in. bolts purchased to use in an opening accurately machined to $\frac{5}{8}$ in. diam. would be expensive. No trouble would be experienced with the bolts that were under exact size, but those which were at all over-size would have to be passed through a special burnishing die and excess metal removed before they could be used. This operation would usually make the bolts more expensive than semi-finished or finished bolts.

It is advisable always to specify allowable tolerances on all bolt orders; maximum allowable size should be given, anyway. If tolerances are large enough to permit the use of plain forged bolts, costs will be lowered by using them, but it is certainly not economy to buy plain bolts, find that many are too large, and have to turn down each one to size in the buyer's machine shop.

Portable Repair Shop

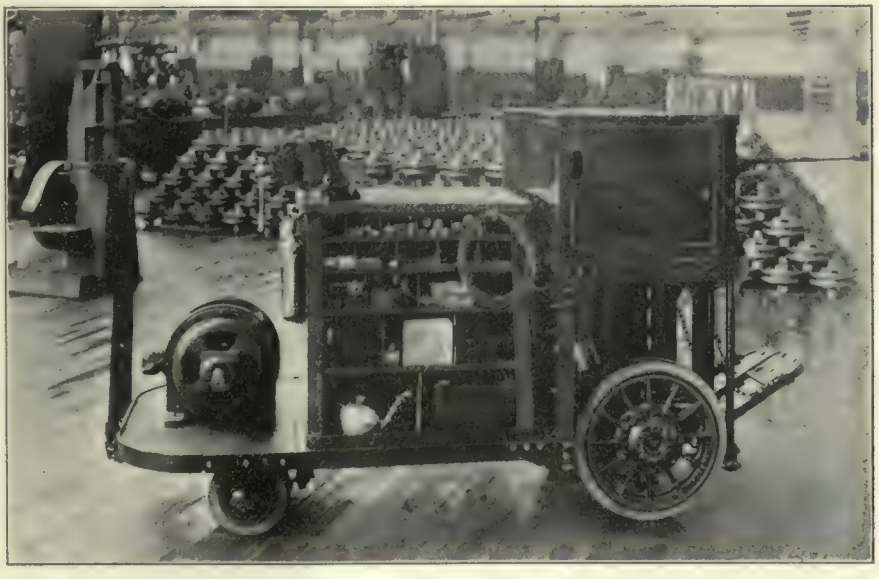
WHEN a breakdown occurs anywhere in the shop, speed in getting repair men on the job, equipped with suitable tools and repair parts, is an important factor in maintaining continuous production.

Some concerns have installed a specially built electric truck for this purpose and have found it to be quite satisfactory. As shown in the illustration, a steel and wood case occupies about two-thirds of the platform. This case is divided into compartments and bins in which are kept fuses, motor brushes, wire cleats, switches, belting and fasteners, lamp bulbs, bearing bushings, a supply of oil and grease, and various items which the repair men have found to be useful in emergencies.

The balance of the platform carries a spare motor, provides space for tool kits and for several repair men to ride. A fire extinguisher is also included as part of the equipment.

When a breakdown occurs, one or more repair men, depending on the size of the job in view, mount the truck and one of them runs it to the scene of the breakdown. No time is lost in collecting tools and equipment, and the run to the repair is made three times as quickly as a man could walk. In nearly every instance, all material necessary for repair is on the job, entirely eliminating the delay caused by one or more trips to the repair shop or storeroom after material.

The truck is driven by a powerful battery carried in a compartment over large rubber-tired drive wheels. Since its operation is simple, anyone can run it.



PORTABLE REPAIR SHOP

THE EDITORS' PAGE

Good Will or Good Management

A GREAT industrial enterprise has just changed ownership, and under its new direction is expected to become one of the largest concerns of the United States—which means the world. Briefly stated, the record is this:

Two brothers, Horace E. Dodge and John F. Dodge, took over a small machine shop in 1901. When the Ford car came on the market they began to produce parts, and became part owners of the Ford Company. After success had been achieved in that venture, they separated themselves from it and built their own automobile. Within 10 years the business expanded from nothing to one of the three outstanding concerns in the automobile industry. Its founders lived to direct its destiny for only six or seven years, but their work was so well done that the property when sold brought the highest cash price ever paid for an American enterprise. A substantial part of this price was reported to be good will.

Such a success is not an accident or stroke of fortune, but is due to good organization and good management. Of John F. Dodge it is said that he was an executive of exceptional qualities in organization and with an unusually happy faculty of dealing with men in the mass. He devoted his efforts to the consideration and determination of management problems in his great industry, and demonstrated the possibilities of securing and maintaining scientific production. In other words, the history of this organization is one of the application of "brains."

The result of this work has now been evaluated in dollars and cents through the sale of the concern. Inasmuch as there is no element of monopoly, either natural or artificial, we have an excellent example of the high value placed upon good management as represented by its result in building an industrial organization. In fact, the item of good will in this transaction, whatever it was, may with perfect truth be re-named "good management."

Maintenance of Man-Power

THE human element in industry affects production directly and to a major extent. While man-power has been multiplied many thousand-fold by the application of machinery, any system of manufacturing will fall down without someone to run it efficiently.

Anything which aids in the maintenance of man-power is of far greater importance than attention merely to upkeep of plant and equipment. A. G. Anderson takes up one element which serves to keep workers fit and active on their jobs, by discussing in this issue the effect which ventilation in a factory has upon output.

Many experiments have been made to determine the relative influence which good air has upon workers. In all, the results in increased production have been positive and conclusive. But just to know vaguely that more product will be turned out is not getting very far. Mr. Anderson explains exactly what constitutes good air, how it may be supplied, and to what extent it adds to output. In a succeeding article, to appear next month, he will discuss roof construction and window installation from the standpoint of ventilation and will show how it is possible to secure desirable air conditions, and incidentally abundant daylight, with comparatively little increased expense.

Workers themselves have not the scientific knowledge nor the authority to determine what constitutes good ventilation in a plant. Physical and mental ill effects will, in time, show up where air conditions are bad. But the fact that employees will work under improper conditions offers no excuse for not improving such conditions. The issue is, after all, squarely up to the management, and Mr. Anderson has written altogether from this standpoint, at the same time actually getting down to "brass tacks."

Proper ventilation would be worth its cost if it only made working conditions more pleasant. But this feature, while an evidence of good management, becomes an incidental when ventilation is regarded in its aspect of increasing production. Every test made has developed specific evidence that output is materially increased spontaneously with an improvement in air conditions. Hence the manager who provides for the comfort of his workers is immediately rewarded himself by the added returns he gets from his investment.

Managing from the Bottom

THERE is plenty of evidence that a shift is taking place in customers' buying methods. This change is away from the order for delivery at some distant date to the order for delivery at once or as soon as the goods can be produced. An example of this tendency is in the purchase of fabrics for garments. Instead of being ordered at least a season in advance. there is a decided tendency toward the order for and when needed.

The reason for this tendency or shift is easily seen. The customer is reducing his own business risk by buying materials only for the output which he can reasonably expect to market. Inasmuch as an active agent in this shift is the consumer of products for re-manufacture, the effect of his action and decision is transmitted backward along the entire manufacturing line. Several important results as they concern the manufacturing establishment are worthy of emphasis.

Inasmuch as orders of this kind are placed for immediate delivery or delivery as soon as manufactured, the manufacturer must either carry a large

inventory, which he probably will not do, or else develop his manufacturing organization to produce as rapidly as possible. The result will be a thin, swiftly moving stream of product to satisfy existing orders, and no stream where orders do not exist. The final effect of such a policy should be to produce at minimum cost as regards material and direct labor.

Another result of this method of purchasing will be to compel the manufacturer to plan "from the bottom up." That is, the date when his customer must have the goods will be fixed, not by the manufacturer, but by the customer. All of the productive processes must be planned and dated from that time back to the day when the order is entered. Here and there a manufacturer has adopted this policy because of its advantage rather than because he has been compelled to do so. In either case the advantage is the same—setting up a rapidly moving production stream to yield the goods when needed and for a minimum expenditure of time, material and direct labor.

If this tendency for customers to buy when and as wanted spreads, as seems likely, the dams behind which large inventories have been held will break and not be repaired. This by-product advantage may prove to be not the least of those which will follow the change.

However, during any period of transition troubles arise. It is probable that the management difficulties of the immediate future will be severe until everybody from consumer through to the producer of raw materials has become adjusted to the resulting economic situation.

Sales Financing Develops Trade

WHEN an article of trade becomes so general in use as to be classed as a necessity rather than a luxury, it is still often beyond the pocketbooks of a majority of people, on a strictly cash basis. But, in order to bring and keep the price down, mass production is necessary, and mass production cannot be carried on without mass sales. Consequently, some means must be provided to move goods in large quantities. The only way to do so is to sell on long-term credit.

Few manufacturers are prepared to undertake the extensive financial operations connected with this method. The risk is great and the details involved call for the experience of the banker rather than that of the manufacturer. Large sums of money are tied up which are probably urgently needed in production.

Hence, the manufacturer has called the financing company to his aid and reserves his own energies for the making of his products. Directly, and through dealers, however, he co-operates in credit selling, but when a sale is made both dealer and maker receive their money, while the financing company advances the ready cash, and the customer pays a reasonable interest in return for the convenience of immediate possession of his purchase.

The automotive industry has worked out a system of financing domestic sales that functions effectively, has probably more than doubled sales, and yet does not hamper the manufacturer in his productive activities. This system is described on page 475 of the present issue by C. C. Hanch, to whom credit for the application of the idea to this particular industry is largely due.

Other groups of manufacturers are becoming interested in the possibilities of the plan. It certainly offers many advantages and is worth careful investigation by all organizations whose selling prices, by the nature of their product, run into relatively large amounts.

Grading Occupational Wages

AN ever-present source of agitation and possible unpleasantness is the conflict of workers in different occupations over the relative value of their work. The window washers think they should be higher paid than floor sweepers; drill press operators are sure their jobs are as important as those of lathe hands. It is a human trait, as prevalent in factories as anywhere else, to consider one's own work of great importance while minimizing the worth of others' labors.

How to reconcile these differences in such a way that the wages paid for each occupational job will reflect the value of that job to the company, and, at the same time, satisfy the workers, is one of management's most ticklish problems.

A happy solution of the problem is presented by Merrill R. Lott in an article appearing in this issue. A scientific method of grading occupational wage rates which is acceptable both to management and men is described in detail. Consideration is given to all factors which influence the value of the work to the company as well as to those that affect the requirements of workers. These factors are weighted and combined to give an index number that definitely locates each occupation in relation to all others.

That this method is unprejudiced and generally applicable is proved by the similarity of results obtained by two different groups. Working quite independently of each other, except as to methods used, grades determined by a management group were almost identical with those resulting from the studies by a group of workmen. When relative wage rates are based on such a study, workmen will cease to complain of relative injustice and an important source of internal friction will be removed.

Management Becoming Exact Science

MANAGEMENT is fast becoming a definite science in detail procedure. At the Spring Meeting of the American Society of Mechanical Engineers, in Milwaukee, May 18 to 21, a session will be devoted to management in steel and iron foundries, probably the last branch of the metal industry to adopt effective management methods. The material handling session will discuss, with actual applications, the revised formulas for determining economies of labor-saving equipment. The American Management Association, at its Chicago conference, May 21 to 22, will contribute definite facts regarding wage incentives in industry.

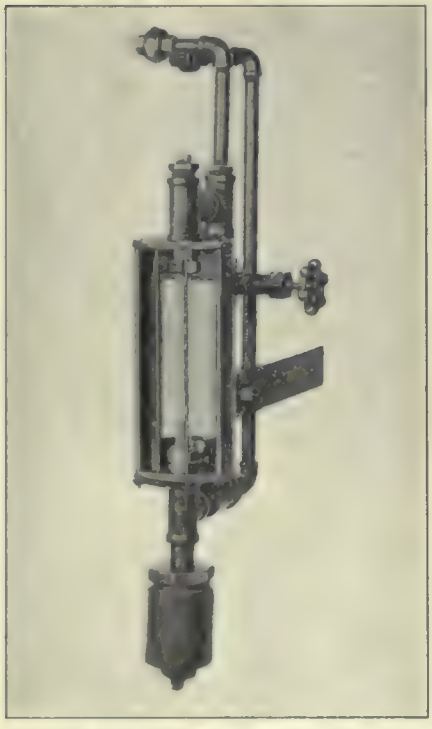
INDUSTRIAL EQUIPMENT
NEWS FOR THE MANAGEMENT

This department is conducted to give our readers essential facts regarding items of industrial equipment recently placed on the market, that may be used to increase production or lower costs. The editors will be glad to furnish additional information about any item. All information given is obtained from reputable manufacturers, and MANAGEMENT AND ADMINISTRATION accepts it as reliable.

Flow Meter

THE Mallen flow meter for measuring the flow of steam, water, or any fluids in pipe lines is being manufactured by Statewide Engineering Co. It is particularly adapted for use in boiler-rooms where installation of two meters, one to measure steam flow or boiler output, and the other to measure feed-water input, gives the boiler operator information that enables him to regulate the furnaces effectively.

This meter utilizes a mercury column

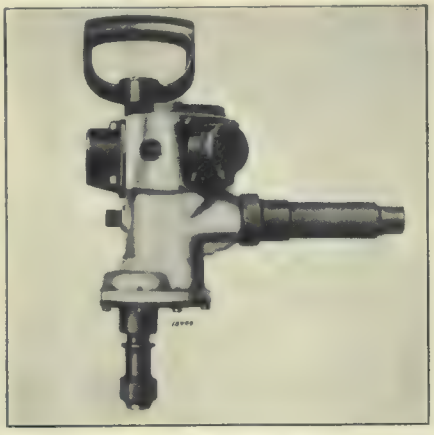


MALLEN FLOW METER

in conjunction with an orifice plate and results with less than 1 per cent error are possible with it. It is very simple in operation and requires no attention, regardless of whether or not the boiler is in operation.

Pneumatic Drill

A LIGHTWEIGHT, reversible, pneumatic drill, especially adapted for wood boring, but suitable for a variety of jobs requiring the services of a lightweight powerful drill, is being marketed by Ingersoll-Rand Co. Features of this machine, called Size DD, are 3-cylinder motor, aluminum case, renewable crank pin sleeve, renewable and interchangeable cast-iron cylinders.



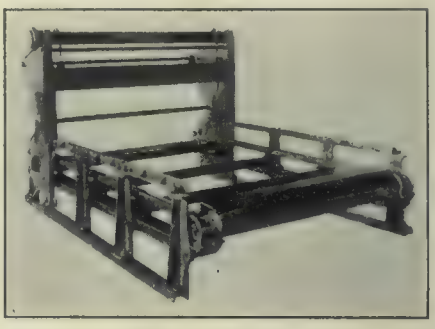
PNEUMATIC DRILL

Rotating parts are accurately balanced to eliminate vibration and reduce wear. Average working speed is 705 r.p.m., weight (including handle and chuck) is 15 lb. The drill is economical in air consumption and maintenance cost, is high powered, and easily inspected.

Traveling Grate Stoker

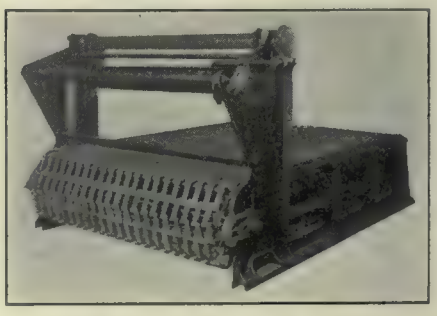
THE United Stokers Company has developed a traveling grate stoker adapted for use in small boiler installations for which is claimed the following advantages: Cheapest grade of coal can be used effectively without production of smoke; coal is fed, and ash removed, automatically and continuously, eliminating cleaning periods and clinker troubles, and reducing amount of ash; high capacities can be maintained indefinitely.

But one pattern is used for the fuel bearing surface, so but one type of grate need be kept as a spare. Grates can be removed or replaced while stoker is running. Either an electric motor or a fully enclosed steam engine can be furnished as a prime mover. The stoker has been designed to serve existing installations with a minimum of changes in brick work. The stoker grate sur-



STOKER FRAME

face is only 24 in. above the floor and a satisfactory setting can be obtained where the shell of a horizontal return



TRAVELING GRATE STOKER

tube boiler is only 5 ft. above the floor. Ashpits require but little more excavation than is required for the average hand-fired furnace.

Combined Gas and Oil Burner

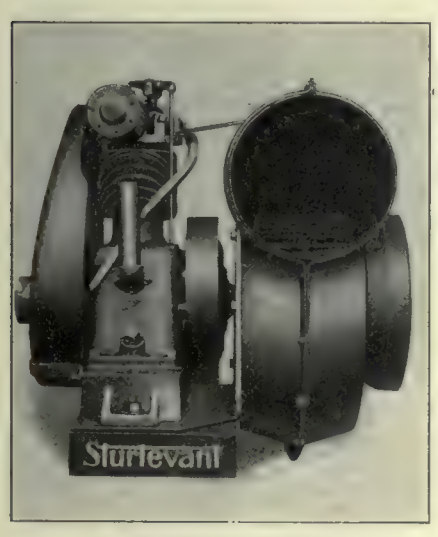
A BURNER, for use on industrial furnaces under boilers, by means of which oil and gas can be burned simultaneously, separately, and change made from one fuel to the other with no mechanical operation except manipulating proper valves, has been developed by Peabody Engineering Corporation. By means of this device industries located where gas is available for fuel can choose between efficient combustion of either gas or oil for providing power, depending upon relative costs,

regularity of supply, etc., or in periods of high peak loads can burn both at once to obtain high boiler capacity.

The burner is easy to operate to obtain efficient combustion with either fuel. Average results of tests show not more than 12 per cent CO_2 with gas and about 14.5 per cent CO_2 with oil. The device consists of a Standard Peabody Fisher burner and air register with a gas burner between the furnace front and the air register. One or more burners are installed in openings made in the furnace wall and control of all valves, and so of combustion, may be centralized.

Engine Driven Fan

AN entirely self-contained, easily portable, gasoline-engine-driven, ventilating fan suitable for temporary or permanent ventilation in places where electricity is unavailable, has been developed by B. F. Sturtevant Company. A single cylinder, 4-cycle, air-cooled engine is direct connected to the fan.



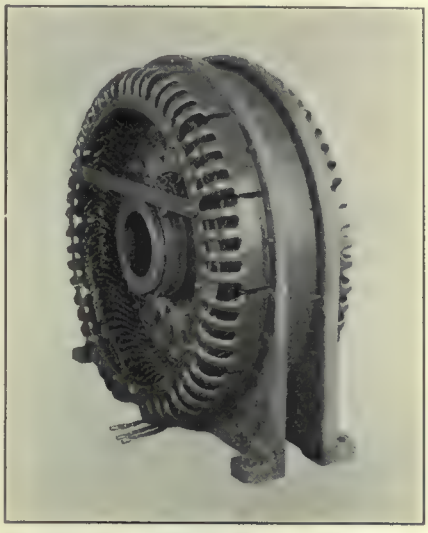
SELF-CONTAINED FAN

It is claimed that a conservative figure for gas consumption is 10 hr. operation on 1 gal. of fuel.

Two sizes are available. The larger —size D—operates at an engine speed from 1300 to 1750 r.p.m., delivers volumes of air from 775 to 1050 cu. ft. per min. and weighs 85 lb. complete. The smaller unit is similar to the D size but delivers volumes from 300 to 450 cu. ft. per min.

Synchronous Motor

FOR direct-drive of low-speed reciprocating compressors used in furnishing compressed air or for artificial refrigeration, General Electric Company has developed a type TS synchronous motor. This motor has been designed to obtain simplicity of the starting operation, starting conditions satisfactory to the power company,

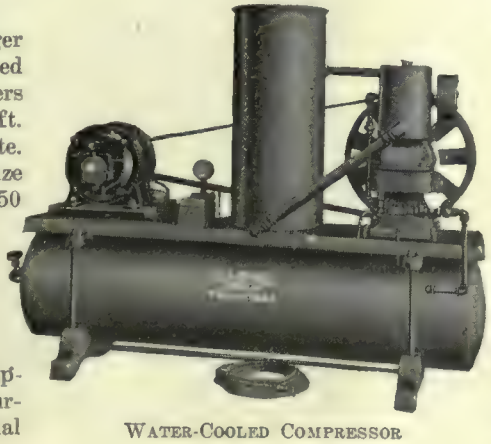


SYNCHRONOUS MOTOR

adequate torques, efficient operation, and minimum flywheel requirements. Motors of this design are being built in more than 300 standard ratings larger than 20 hp. at 60-cycle synchronous speeds between 72 and 450 r.p.m.

Water-Cooled Air Compressors

A LINE of water-cooled air compressors for general use in industrial plants is being marketed by Globe Manufacturing Company. Equipment R-50 is designed for use in large establishments or where continuous operation is required. Operates at 250 r.p.m. or 400 r.p.m. with power requirements of 3 hp. or 5 hp. and air displacements of 12 or 20 cu. ft. per min. Max. pressure 200 lb. Types R-54 and R-54 S are 3 and 5 hp. equipment similar to R-50, but with motor furnished. R-458 and R-458S include storage tank. All types with exception of R-50 are equipped with automatic control.



WATER-COOLED COMPRESSOR

Dust-Proof Hanger Seal

FOR use on power transmission shaft hangers, in places where there is an unusually large amount of dirt such as exists in cement mills, steel mills, flour mills, grinding rooms, woodworking plants, etc., Fafnir Bearing Company has developed a device to prevent dust and dirt from entering and affecting the efficient operation of bearings, whether ball or plain.

The seal is an extension of the self-locking collar, enclosing the end of the box and fitting over the corners so as to prevent dirt working down. Corners of the hanger box are cut down and have a ridge to stop any dirt that might enter. Since the seal revolves with the shaft and collar it also tends to throw off the dirt by centrifugal force.

Portable Air Turbine Motor

A LIGHTWEIGHT pneumatic motor for use with wire brushes to clean castings, steel blooms, etc., has been developed by the Standard Turbine Corporation. The motor consists of a turbine wheel operating at 12,000 to 18,000 r.p.m. geared with single or double reduction to a low speed shaft operating the brush. Air admission is regulated by a trigger.

Bearings are grease lubricated. No load speed is less than ⅛ of tested safe speed of turbine wheel. Casing is aluminum and total weight of motor without brush is 9½ lb. It is claimed that this motor has less vibration and lower upkeep cost than a reciprocating motor.

New Wire Rope

A NEW type of wire rope for use in elevator cables, slings, hitches, cableways, haulage lines, etc., which resists unstranding, which may be cut at any point for splicing and otherwise handled without seizing, and for which is claimed longer life than ordinary rope under reversed bending stresses, is being made by American Cable Company. The wires and strands of the rope are "preformed" to the exact shape they must have to fit correctly

in the rope when it is ready for use.

With this Tru-lay rope has been developed the Tru-loc, a fitting which fastens over the end of the rope and which can be threaded, equipped with heads of various types for wrenches, eyes, or hooks.

Crank-Case Oil Reclaimer

A DEVICE by means of which the products of combustion, debris of wear, road dust, and fuel dilutants can be removed from the oil used in crank-cases of motor trucks and automobiles, and the oil restored to its original lubricating condition, has been developed in the research laboratories of General Electric Company.

OIL RECLAIMING DEVICE

Reclaimed oil is darker in color than the original but can be bleached by Fuller's earth. It may be more stable after reclamation. One batch of oil has been used in an automobile for three years, during which the car was run 11,000 miles. The original oil, with additions to replace consumption, is still in use and gives promise of definite life. Carbon deposits are somewhat less than usual and softer.

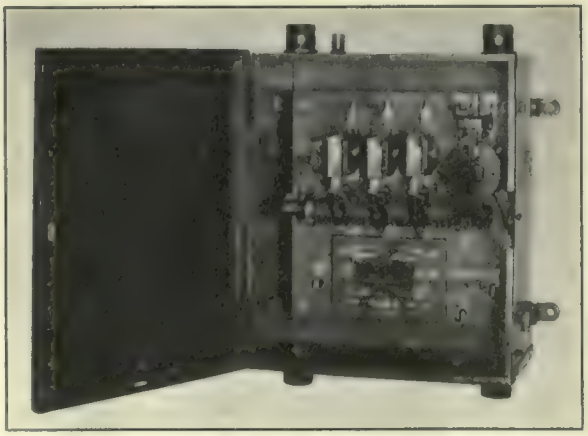
The apparatus is automatic in operation and occupies little space. Major steps of the reclamation process are clarification by agitation, and rectification in which a thin film of oil is run over a heated surface in an air current.

Motor Starters

THREE new types of starters for use with 2- and 3-phase AC motors and with synchronous motors have been developed by General Electric Company.

STARTER FOR SYNCHRONOUS MOTORS

Type CR-7006 D9 has been developed for starting large AC motors. It can be operated by push button, pressure governor, float switch, or similar device.



AC MOTOR STARTERS

Synchronous motor starters are completely automatic, have temperature overload relay, a definite time relay, and a field relay. CR-7065 is for use with slow-speed motors driving pumps, compressors, and general applications. CR-7061 is for use with medium- and high-speed motors for driving pumps, motor generators, etc.

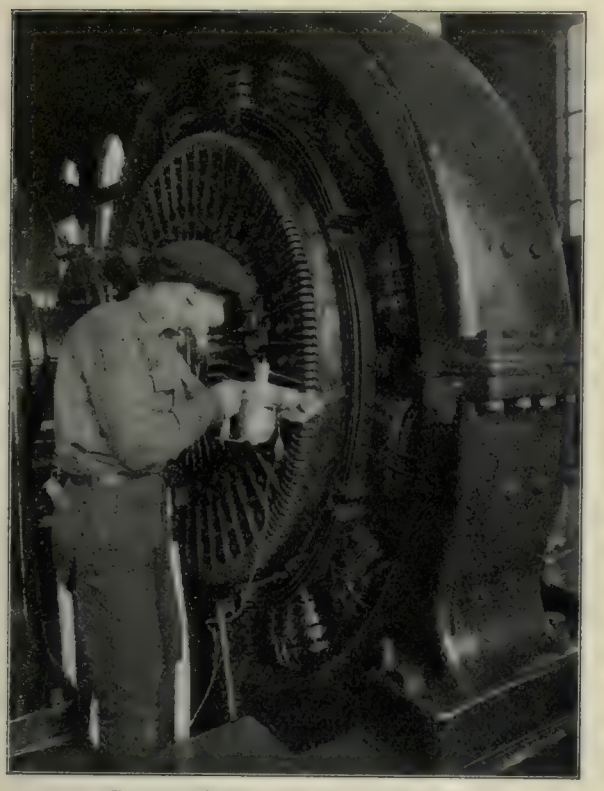
Machine Cleaning Device

A DEVICE for vacuum cleaning or blowing dust and dirt from electric motors and equipment, machinery of all kinds, and other places where ordinary cleaning methods are ineffective, is being marketed by the Martindale Electric Company.

VACUUM CLEANER FOR MACHINES

It consists of a small but powerful electric fan enclosed in an airtight case in which are openings for dust bag and nozzle. The entire apparatus is carried from a shoulder strap, making it easy to handle. Power is supplied through an extension cord which can be plugged in to any light socket. A complete set of attachments, including hose, rubber nozzle for use around electrical equipment, blower nozzle, etc., is furnished.

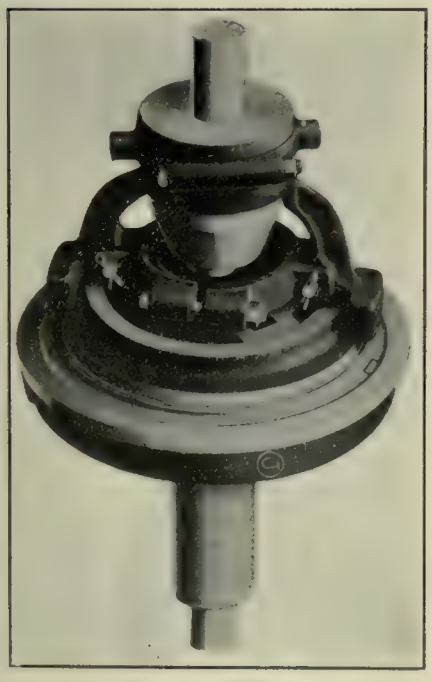
When used as a blower, air is delivered from the nozzle at a velocity of 200 ft. per sec. Cost of operation is less than one cent per hour.



CLEANER BEING USED AS A BLOWER

Friction Clutch

A MEDIUM and light duty clutch which can be conveniently applied to practically any machine or countershaft that requires a friction clutch has been developed by W. A. Jones Foundry and Machine Co. It has few parts, all of which are in plain view and accessible. No special tools are required to adjust or disassemble.



FRICTION CLUTCH

Free floating friction rings of fiber or asbestos brake lining material are used. Model "F" is furnished as sleeve clutch, cut-off coupling, or bolted to the arms of pulleys, sprockets, gears, etc.

Jacket Water Cooler

A DEVICE for cooling jacket water from oil and gas engines and compressors has been developed by The Griscom-Russel Company. It permits a small amount of distilled water to be used in the jackets, thus eliminating scale, but provides efficient cooling at all times.

A removable tube bundle supported by a continuous helical baffle contains raw cooling water. Jacket water takes a long smooth path around the tubes and gives up its heat to the cooling water. The unit is compact and has working pressure of 50 lb. per sq. in. for outside shell, tube and heads.

Concrete-Waterproofing Paint

FOR painting industrial buildings, floors, elevator pits, basements, and all other surfaces of concrete, brick, and stone, The Master Builders' Company has developed Mastertex. This can be applied to wet surfaces, contains no oil or volatile elements to deteriorate, and both decorates and waterproofs the surface to which it is applied.

Mastertex is a fine dry powder which is mixed with water to form a paint which is not affected by elements from outside or in the concrete. It is also used to protect steel and iron structures from rust and corrosion. It can be applied with spraying equipment as well as by brush. Seven colors are available.

Equipment Catalogs

GENERAL catalog No. 30, just issued by W. A. Jones Foundry and Machine Company, contains 448 pages of power transmission data including gears, speed reducers, pulleys, clutches, hangers, couplings, etc.

General Electric Company has issued Bulletin No. 47640.2 describing design, operation, and applications of four types of induction, time, over-current relays.

The Poole Engineering and Machine Company has issued Bulletins 105 and 106 describing their Type H and Type K speed transformers.

In a 16-page booklet, Wagner Electric Corporation describes and gives specifications for its line of electric fans.

Link-Belt Company has published a book describing the applications of skip hoists and their relation to other mechanical equipment.

"Do You Know How Poole Gears Are Made?" is a 4-page folder issued by The Poole Engineering and Machine Company describing the methods used in producing their gears.

"The A B C of Safety Switches" is a booklet issued by Westinghouse Electric and Manufacturing Co. It deals with the uses, designs, and principles of operations of all types of safety switches.

Bulletin No. 1801, issued by American Blower Company, contains 71 pages of descriptive matter, and design and operating data concerning the complete line of "Sirocco" fans.

"G. E. Welding Electrodes" is the title of a 16-page illustrated booklet issued by the General Electric Company, which describes the characteristics and applications of General Electric electrodes.

Philbrico Jointless Firebrick Company has issued a 36-page booklet called "Refractories and Furnace Design." It contains chapters on causes of furnace troubles, and the use of Philbrico in various installations.

Goodman Manufacturing Company has issued Book No. 250, containing illustrations and descriptions of their extensive line of electric locomotives for industrial services.

Barrett-Cravens Company has issued Bulletins No. 100, 101 and 103, which give detailed descriptions of the Barrett Model "F" lift trucks. Bulletin No. 300 describes their line of portable elevators.

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 100 magazines; it also includes the publication of some 50 book publishers and professional societies as far as these are of managerial interest to industrial executives. The decimal number at the right of each item is the index number according to the Dewey Decimal Classification System and indicates the place the article or book will take when filed in accordance therewith in the classified subject scheme. If articles are grouped according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. Photostat copies of any magazine article indexed will be supplied by The Ronald Press Company within a year following the date of publication at a price of 25 cents the page. When ordering photostats please identify the article by quoting from the index: (1) Title of article; (2) Index number; (3) Name, date, and page number of periodical in which the item appears. A remittance of 25 cents a page should accompany the order. The books and pamphlets indexed can be procured from The Ronald Press Company or from their respective publishers.

Industrial Buildings and Plant Maintenance

Buildings and Equipment

Designing the Pickling Department for Economy in Maintenance—I. 658.23
C. A. Crawford. *Iron Trade Review*, April 2, 1925, pp. 875-877. Illus. Flooring, ventilation, tanks and their material and construction, and type of material-handling equipment necessitated because of presence of acid.

Dividends from Air. 658.25
W. B. Spooner, Jr. *Factory*, March 1925, pp. 446-450, 522, 524, 526. Examples of the devices and methods used to clean air for human breathing and industrial processes.

Economic Factors of the Office Building Project—I. 658.2
Leo J. Sheridan. *Buildings*, March 25, 1925, pp. 652-660. Relation of building space to business factors, selection of site, rentals, size and shape of lot, height limitations, building codes, subsoil, construction cost estimating, economic life.

Elevator Characteristics and Building Design. 621.86
A. G. McLaughlin. *Buildings*, March 25, 1925, pp. 644-647. Standardization, principle of operation, and methods of rigging different types of elevators.

Final Report on the 1924 California Air-Cleaner Tests. 658.25
A. H. Hoffman. *Journal of the Society of Automotive Engineers*, March 1925, pp. 367-371. Illus. Conclusion of data presented in the August 1924 issue, showing how an air filter increases the life and lowers maintenance costs on automotive equipment.

Garden Spots of Industry. 658.21
John A. Piquet. *Industrial Management*, March 1925, pp. 145-151. Illus. Reasons why various typical American manufacturing plants selected their present locations.

General Layouts and Designs of Car Shops. 658.2
Report of American Railway Engineering Association Committee. *Railway Review*, March 14, 1925, pp. 510-513. Illus. Methods of shopping freight cars for repairs, shop capacity, determination, painting of cars, specifications for shops and equipment.

Heating, Cooling and Ventilating System for Office Building. 658.25
J. S. Moulton. *Power*, March 10, 1925, pp. 377-378.

How to Choose the Right Location for a Candy Factory. 658.21
Morgan C. Farrell. *Candy Factory*, April 1925, pp. 30-31.

How We Organize and Plan Big Building Operations. 658.2
L. J. Horowitz. *Engineering News-Record*, March 12, 1925, pp. 428-431. Gives organization chart for the administrative functions which must be exercised in erecting a large building or plant.

Southern Builds Modern Equipped Locomotive Shops. 658.2
Railway Mechanical Engineer, March 1925, pp. 165-175. Illus. New shops at North Birmingham, Ala.; their layout, lighting, handling equipment, machine drive, storing methods, management and report system, and decrease in operating costs which has been brought about.

Too Much or Too Little Light Curtails Output. 658.24
Russell J. Waldo. *Canadian Machinery*, April 2, 1925, pp. 23-24. Illus. An analysis of the value of the proper degree of light for the worker based on the reports on the factory branch of the Ontario Department of Labor.

Good Shop Air Stimulates Mental and Physical Effort. 628.8
A. G. Anderson. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 439-442. Illus. Gives data regarding the effect of ventilation on production, and states the conditions of temperature, humidity and circulation of air necessary for health and maximum output.

Maintenance and Repair

Maintenance: Gearing Up Both Plant and Equipment for Low-Cost Production. 658.58
K. D. Hamilton. *Factory*, March 1925, pp. 419-424, 478. Methods of the George E. Keith Company in the up-keep, repair and maintenance of electric motors.

Maintenance: Gearing Up Both Plant and Equipment for Low-Cost Production—The Part That Paint Plays. 658.58
K. D. Hamilton. *Factory*, April 1925, pp. 586-591, 632-640. Illus. The part that paint plays in the maintenance, upkeep and preservation of plant and industrial buildings.

Mechanical Painting of Industrial Plants. 698
Keene Richards. *Industrial Engineer*, April 1925, pp. 173-177. Illus. Methods used at the 9 Grennan bakeries to reduce the labor cost and speed up the work to avoid interference with production. Specifications for various types of industrial jobs.

Plant Inspection and Maintenance Schedule. 658.58
George E. Gaster. *Power*, March 10, 1925, pp. 373-374. Method and schedule for plant inspection and repairs applied more particularly to power plant equipment.

Specialized Inspection Reduces Pull-Ins on Kansas City Railways. 658.58
Electric Railway Journal, February 28, 1925, pp. 329-332. Illus. Trained men on inspection work are responsible for maintenance of rolling stock. Each has charge of a definite group of cars. Graphic records help check performance.

System for Controlling Motor Bus Maintenance. 658.58:656.124
R. E. Fielder. *Journal of the Society of Automotive Engineers*, March 1925, pp. 345-354. Illus. Methods used by the Fifth Avenue Coach Company, New York, most of which will apply to industrial operation of a truck fleet.

General Management and Policy

Administration and Policy

Aims and Progress of the Large Machine Tool Building Industry. 621.9
(Bestrebungen und Fortschritte des Grosswerkzengmaschinenbaues.) Weil. *Zeitschrift des Vereines Deutscher Ingenieure*, February 21, 1925, pp. 249-256. Illus. Review of the various types of machines and their applications.

Application of Engineering Principles to Economic Problems in the Textile Industry. 677
Mechanical Engineering, April 1925, pp. 274-276. Outline of how to apply engineering principles in solving the operating problems in the textile industry and a discussion thereof.

Engineering in Stone Production. 658
C. C. Griggs. *Cement, Mill and Quarry*, March 5, 1925, pp. 12-13. Necessity for a capable engineer to investigate, equip and develop a quarry if it is to be profitable.

The Four Policies on Which We Built a $10,000,000 Business. 658
Charles S. Pearce. *System*, April 1925, pp. 477-480, 560, 562. Illus. Policies of developing products, selling them effectively, maintaining moderate prices, and giving workers adequate pay, have built a business of $27,000,000 annual volume for the Palmolive Company.

Getting the Most Out of Your Machine Tool Dollar. 658.581
J. A. Smith. *American Machinist*, March 12, 1925, pp. 409-411. A general analysis of the causes of uneconomical operation of machine tools. Outline of a system of records which show difficulties met with in operating machines, and their causes.

Getting the Most Out of Your Machine Tool Dollar. 621.9
C. A. Shaffer. *American Machinist*, April 2, 1925, pp. 521-522. General statement of the advantages to be gained in railroad shops by replacing worn and obsolete machinery with modern equipment. Has point of view of the mechanical department of the Illinois Central Railroad.

How Our Factory Works Hand in Hand With Our Sales Department. 658
T. H. Kane. *Factory*, April 1925, pp. 581-584. Outline of manufacturing plan, sales and advertising methods, and financial provision which have contributed to the growth and expansion of the Truseon Steel Co.

How the Dennison Manufacturing Company Meets Its Slumps. 658.5
Johnson Heywood. *Advertising and Selling Fortnightly*, March 11, 1925, pp. 15-16, 72-75. Review of methods used to overcome effects of the 1920 depression.

Industrial Standardization. 658.516
F. L. Rhodes. *Journal of the Society of Automotive Engineers*, March 1925, pp. 379-380. Basis of work, requisite nature of standards, stating specifications, determining tests, and need of flexibility, taken from the experience of the Bell Telephone System.

Manufacturing Organization and Machine Tools. 338
(Fabrikorganization und Werkzeugmachine.) A. Wallichs. *Zeitschrift des Vereines Deutscher Ingenieure*, February 21, 1925, pp. 222-225. Illus. Aims of modern management of industry, development of German machine tool manufacturing, place of machine tools in fabrication plans.

Mixing Concrete for the Market. 658.666
W. E. Hart. *Cement, Mill and Quarry*, March 5, 1925, pp. 17-19. Commercial product should be under control of makers of original materials. Advantages and disadvantages of the central mixing plant.

Net Profits from Modern Equipment. 621.9
Frank A. Scott. *The Iron Age*, April 2, 1925, pp. 957-961. Illus. Installation of modern machine tool equipment is usually a profitable undertaking.

132 Years Without Losing a Customer. 658
Charles Lukens Huston. *System*, April 1925, pp. 461-466, 534. Illus. Growth and development of the Lukens Steel Company. Policies on which the company has built.

A Plan That Keeps Executives on Their Toes. 685.56
A. J. Beatty. *System*, April 1925, pp. 459-460. Illus. The American Rolling Mill Company develops a rating scale for application to executives.

Picking the Profitable Products. 658
Rudolph Rosenthal. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 429-431. Methods used in a small plant, whose principal product is mirrors, to determine the margin between cost and selling price for its various lines and sizes. The information once secured shows what products are profitable and what are sold at no profit or at a loss.

What Is a Trade Mark? 608
Walter C. Hughes. *Candy Factory*, April 1925, pp. 28-29.

What Users Want in Machine Tools. 621.9
Robert R. Keith. *Iron Trade Review*, April 2, 1925, pp. 878-879. Illus. Experiences of the International Harvester Company point out difficulties in layout, maintenance and operation of machines, due to faulty lubrication, inadequate bearings, etc.

Economics

The Banker and the Engineer. 332.1
H. Birchard Taylor. *Railways*, March 1925, pp. 586-588. Relation of the engineer to the banker, and a discussion of the subjects on which the former should have knowledge to enable him to qualify as a manager.

Electrotechnic in the Iron Industry. 621.3
(Die Elektrotechnik im Eisenhütten werk.) D. W. Geyer. *Zeitschrift des Vereines Deutscher Ingenieure*, February 14, 1925, pp. 175-178. Influence in development of industry, material handling and transporting equipment, fabricating machinery, power generation, air equipment, rolling mill machinery and making of electrosteel.

German Metal Workers' Federation Study of the German Automobile Industry. 629.113
Alfred Maylander. *Monthly Labor Review*, March 1925, pp. 5-22. Statistics on the industry, its factories, labor, wages, combinations, technical problems, competition both domestic and from foreign sources, etc.

Industry's Use of Lumber as Great as That of Construction. 674.61
John M. Carlisle. *Michigan Manufacturer and Financial Record*, March 28, 1925, pp. 3-4, 26. Illus. Data on quantities and uses of lumber consumed in Michigan industries, and economies brought about in boxing and crating methods.

Iron Industry and the Business Cycle. 338 97
Harold B. Vanderblue and William L. Crum. *The Iron Age*, March 26, 1925, pp. 896-899. Methods for eliminating seasonal variation and effects of long time trend from pig iron statistics so they may be compared with indexes of general business activity.

Making Conservatives Out of Radicals. 331.1
S. F. Fannon. *Black Diamond*, March 28, 1925, pp. 374-375. Elements in industrial life which make for disloyalty to America and hatred of capital. Dollars and cents meaning to employers. Education the cure.

No Need to Fear Britain or Germany in Foreign Markets. 382
Julius Klein. *Printers' Ink*, April 2, 1925, pp. 25-26, 28, 33. Some information concerning the condition of our foreign trade.

Progressive Variation in Seasonality. 311
W. L. Crum. *Journal of the American Statistical Association*, March 1925, pp. 48-64. Illus. Investigation of the nature, causes and methods of handling seasonal variation in business and industrial statistics.

Responsibilities and Obligations of the Technical Man. 6(07)
Frank H. Alfred. *Railway Review*, March 14, 1925, pp. 541-543. Possibilities for engineering achievement, obligation of engineer in solving national engineering problems, responsibilities as a citizen.

The Truth About Germany's Industrial Revival—II. 33
Sir Philip Dawson. *Industrial Management*, March 1925, pp. 129-136. Post-war administration, communism, taxation policies, inflation and its internal results, recklessness of expenditures, and upsetting of the social and economic equilibrium.

Management

The Application of Industrial Engineering to the Coal Mining Industry—II. 658
Jerome C. White. *Coal Mine Management*, March 1925, pp. 29-31, 54-55. Organization and control, budgeting, applying statistics, estimating sales, co-operation between departments.

Control Chart for the Chief Executive. 658.53
Wallace Clark. *The Iron Age*, March 19, 1925, pp. 828-831. Illus. Description of chart based on Gantt progress chart for use in keeping executive informed of operating conditions.

How to Keep Invention Records. 608
H. A. Toulmin, Jr. *Factory*, April 1925, pp. 598-601. Illus. Description of a method of keeping record of inventions in order that dates may be proved in case of patent litigation.

Instruments for Automotive Research. 658
John A. C. Warner. *Journal of the Society of Automotive Engineers*, April 1925, pp. 468-469. Design and operation, cost factors, motion analysis, motion picture and stroboscopic methods, study of noise.

Internal Organization of a Manufacturing Company. 658
National Association of Cost Accountants Official Publications, April 1, 1925, Brief outline of the functions of the operating departments of a manufacturing concern. These are divided into: manufacturing, selling and distribution, general administration.

Keeping Promise Is Important Factor in Commercial Machine Work. 658.5
H. B. and O. C. Sabin. *Iron Trade Review*, March 12, 1925, pp. 690-692. Illus. Phases of contract production work, and methods of estimating costs and filling orders on time.

The Management Function in Business. 658
J. Gordon Steele. *National Association of Cost Accountants Official Bulletin*, March 16, 1925, pp. 3-12. A general discussion of its topic written around the three subfunctions, of organizing, preparing and directing.

Management Improvements in the Rubber Industry. 658:678
Sanford E. Thompson and Willard E. Freeland. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 447-450. Review of good management essentials, illustrated by examples from many plants.

Net Profits from Modern Equipment. 658.5
Frank A. Scott. *Iron Age*, April 2, 1925, pp. 957-961. Examples of results of a progressive policy which lowers production cost and thus selling price by the adoption of improved equipment.

Our Gains from Balanced Organization. 658.5
M. H. Karker. *Factory*, March 1925, pp. 411-413, 462, 464, 466, 468. Methods used by the Jewel Tea Company in developing a $4,000,000 business in 12 years. Emphasis is laid upon the method of balancing the organization.

Oxygen Purity and Cutting Efficiency. 665.8
John J. Crowe and George L. Walker. *The Iron Age*, March 19, 1925, pp. 824-827. Illus. Results of investigation of economies possible from use of high purity gas in oxy-acetylene cutting of steel.

Proposed Standards for Commercial Forms. 651.72
Mechanical Engineering, April 1925, p. 300. Brief statement in regard to recommended standard sizes for invoice, inquiry and purchase-order forms. Recommendations are: 8½ x 7 in., 8½ x 11 in. and 8½ x 14 in.

Reducing Losses from Obsolete Material. 658.5671
Metropolitan Life Insurance Company Leaflet, 11 pp. Résumé of methods used by manufacturing and merchandizing concerns.

Reciprocal Buying Contagious. 650
E. C. Barringer. *Iron Trade Review*, March 12, 1925, pp. 685-686, 698. Practice of placing orders for finished products to sell raw materials, in return, to the maker is permeating every sort of business, not always to the liking of the engineer.

The Scrap Problem in the Small Plant. 658.567
Richard Cragin Daniels. *Factory*, April 1925, pp. 615-618, 702. Illus. Methods and suggestions for the handling of nonferrous scrap to get the highest money return. Tells how to sell copper and brass to both rolling mills and smelter and how to classify various grades and kinds.

Screw Thread Tolerances. 658.516
(Die Gewindetoleranzen.) N. Breuer. *Werkstattstechnik*, February 15, 1925, pp. 132-133. Discussion of the provisions of the German standard.

Some Manufacturing Problems of the Cement Industry. 658:666.9
John J. Porter. *Cement, Mill and Quarry*, March 5, 1925, pp. 22-25. Chemical composition, correct burning, grinding, kiln linings, dust prevention, output and fuel economy, and factors affecting cost.

Some Scientific Instruments for Gas Works. 665.7
H. A. Randall. *The Gas World*, March 7, 1925, pp. 190-191. Descriptions and uses of electrical distance thermometers, automatic temperature controllers, CO_2 indicators and recorders, etc.

Tool Salvage. 658.563
L. A. Churgay. *Journal of the Society of Automotive Engineers*, April 1925, pp. 458-460. Discussion of paper appearing in the November 1924 issue of the Journal.

Utilizing Motor-Truck Service Records. 658.5:656.124
S. V. Norton. *Journal of the Society of Automotive Engineers*, March 1925, pp. 372-378. Illus. Organization of the service department of the General Motors Truck Company, its testing and inspection methods, reports and forms, co-operation with branch offices and distributors, and results accomplished.

$612,955 Saved by Waste Reclamation. 658.567
A. L. Kelligon. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 457-460. Illus. The Southern Pacific Railroad has 4 waste reclamation centers on its Pacific system where $612,955 was rescued from scrap in one year, and a total of $2,531,878 was saved by this and other economies in the use of materials.

Power Generation and Transmission

Fuel

Carbon Losses in Ashes of Boiler Fuel. 621.18
L. M. Marks. *Steam Power*, March 1925, pp. 6, 14. Causes of carbon losses with suggestions for their prevention.

Facilities for Fuel Oil for Locomotives. 621.18
Report of American Railway Engineering Association Committee. *Railway Review*, March 14, 1925, pp. 499-504. Illus. Unloading facilities, fire walls, roofs of storage tanks, concrete tanks, delivery to tenders, heating oil to increase rate of flow.

How the Chicago Great Western Controls Use of Locomotive Fuel. 658.5:656.2
Railway Mechanical Engineer, March 1925, pp. 144-146. Illus. Methods, competition and prizes, and results.

Oil—The Gas Man's Next Problem. 662.6
William M. Carpenter. *American Gas Journal*, March 7, 1925, pp. 201-202, 213-215. Illus. The oil situation as affected by the demand for gasoline, relation between petroleum distillates, production, and oil supply. Relation of oil to gas as a source of raw material and as a competing fuel.

Operating Experiences in Pulverized Fuel. 658.26
Paul W. Thompson-E. H. Tenny. *Mechanical Engineering*, April 1925, pp. 271-272. General results from pulverized coal fuel from the Detroit Edison Co., and the Union Electric Light and Power Company.

Pulverized Coal at Trumbull Steel Mills. 621.18
The Iron Age, March 26, 1925, pp. 885-888. Illus. Reduction in labor force and use of cheaper grade of coal made possible with new equipment which serves boilers and annealing furnaces.

Pulverized Fuel and Its Application to Boiler Firing. 621.18
W. J. Cotterell. *Combustion,* April 1925, pp. 275-278. Advantages of pulverized coal and some of the things which should be considered before its adoption.

The Storage and Handling of Fuel Oil in Industrial Plants. 658.78:662.6
C. G. Sheffield and H. H. Fleming. *Universal Engineer,* March 1925, pp. 32-34.

The Value of Analyses. 621.18
A. B. Greenleaf. *Industrial Gas,* March 1925, pp. 9-10. It is not "what a fuel costs" but "what does it cost to use the fuel" should govern selection.

Power Equipment

Automatic Feed Water Regulation. 621.18
Mechanical World, March 6, 1925, pp. 149-150. Descriptions and applications of various types of regulating devices.

Combustion Devices for Solid Fuels. 621.18
W. Trinks. *Fuels and Furnaces,* March 1925, pp. 233-239. Illus. Description and applications of various devices.

Failure of Oil Fuel Details (Causes). 621.18
F. J. Drover. *Cassier's Industrial Management,* March 1925, pp. 202, 204. Practical suggestions for determining reasons for failure of oil-burning devices and methods which may be used to remedy poor conditions.

Gas Combustion Systems. 621.18:662.76
H. F. Rehfeldt. *Industrial Gas,* March 1925, pp. 15-16, 20. Illus. Review of the various systems of gas combustion with reference to the conditions and applications where each is used.

Heat Insulation Economy. 621.18
L. B. McMillan. *Steam Power,* March 1925, pp. 5, 10, 12. Charts. Possibilities of saving fuel by properly insulating steam pipes and heat-radiating surfaces.

Industrial Use of the Oil Engine. 621.18
L. H. Morrison. *Mechanical Engineering,* April 1925, pp. 255-257. Discusses the adaptability of the oil engine to the production of cheap power for industrial uses in small units. An opinion is expressed that the oil engine will be a major factor in the decentralization of a factory system.

Recuperation and Recuperators. 621.18
Charles Longenecker. *The Blast Furnace and Steel Plant,* March 1925, pp. 120-121. Discussion of various types of heat recovery devices now in use.

Remodeling a Coal Mining Company's Power Plant. 621.18
E. C. Moan. *Modern Mining,* February 1925, pp. 38-45. Illus. Removal of obsolete type of engine equipment and replacement with turbine unit at the Emmons Coal Mining Company accomplished by the company's engineers without outside aid. Description of present plant and its operation.

Stationary Power Plants for Railroads. 621.101
Paul R. Duffey. *Railway Mechanical Engineer,* March 1925, pp. 146-148. Illus. Classification, buildings and equipment, other facilities, operation and management.

Waste-Heat and Gas-Fired Boilers. 621.18
Iron and Coal Trades Review, March 6, 1925, p. 395. Illus. Apparatus for utilization of waste heat from coal-carbonizing plants and generation of steam in gas-fired boilers, with typical heat balances.

Power Plant Operation

Allocating Power Cost to Product. 658.26
Walter N. Polakov. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 433-436. Illus. A study of power generation and distribution is vitally necessary in the manufacturing plant in order to establish correct selling prices for product, and to stop power leaks.

Cutting Costs in the Boiler Plant. 658.261
W. S. Cramer. *Water Works,* March 1925, pp. 542-543. Methods of reducing the coal bill at the Lexington, Ky., Water Co. Paper presented at the American Water Works Association convention.

The Dollars and Cents of Low Power Factor. 658.26
Ottomar H. Henschel. *Industrial Management,* March 1925, pp. 139-144. Illus. Detrimental effects of a low power factor, and corrective measures and their results in a pressed and drawn steel products plant.

Economies Effected by Insulating Train Steam Pipes. 658.25
William N. Allman. *Railway Mechanical Engineer,* March 1925, pp. 160-161. Insulation of 3 types, and savings in heat which they make possible.

How We Reduced Our Power Costs. 658.26
Industrial Management, March 1925, pp. 183-188. Various methods used to improve operation in factories, a railroad system and a mine.

The Improvement of Power Factor—II. 658.26
Miles Walker. *World Power,* March 1925, pp. 153-156. Suitable apparatus, its application, installation, and operation.

Modern Power Management. 658.26
(Neuzeitliche Energiewirtschaft.) H. von Glinski. *Zeitschrift des Vereines Deutscher Ingenieure,* February 7, 1925, pp. 141-147; February 14, 1925, pp. 179-184. Illus. Fundamental principles, methods and media, present development and future outlook of power generation as influenced by electricity. Points on the building and operation of steam and hydroelectric plants; distribution of energy over wide areas. Tasks of management.

Saving Fuel by Treatment of Feed Water. 658.26
W. A. Pownall. *Steam Coal Buyer,* March 1925, pp. 42, 44. Illus. Description of successful method of water treatment used on boilers, aggregating several hundred thousand horsepower.

Smokestacks Are Good Indicators Showing When Fuel Is Wasted. 658.26
E. Winholt. *Steam Coal Buyer,* March 1925, pp. 31-32. Illus. What smokestacks show and how indicated poor conditions can be improved.

Steam—Economy of Generation and Utilization. 658.26
C. A. Schlegel. *Gas Age-Record,* March 7, 1925, pp. 333-336. Charts. Review and discussion of equipment and methods necessary for steam economy.

The Storage of Coal. 621.18:658.78
Steam Power, March 1925, pp. 8, 14. Suggestions for coal storage to prevent fires and excessive deterioration.

Super-Power and Its Future in Britain. 621.31003
World Power, March 1925, pp. 129-133. Population and the power zone, capital costs, fuel economy, station efficiency, and comparison with America.

Waste-Heat and Gas-Fired Boilers. 658.26
James W. Reber. *The Gas World,* March 7, 1925, pp. 184-189. Summary of the methods for utilizing waste heat to generate steam and the use of gas-fired furnaces. Considerable data concerning design and operation are given.

World's Largest Diesel Engined Cement Plant. 621.3
Cement, Mill and Quarry, March 5, 1925, pp. 43-48. Description of the Diesel electric plant of the Lehigh Portland Cement Co., at Iola, Kan., which has been in operation since 1916.

Power Transmission

Changes That Have Taken Place in Bearings. 621.82
L. A. Hillman. *Industrial Engineer,* March 1925, pp. 127-130. Illus. Development of the sleeve, ball and roller bearings from ancient times to the present.

Enclosing and Lubricating Silent Chain Drives. 621.85
Paul Wheeler. *Industrial Engineer,* March 1925, pp. 133-135. Illus. Practical methods to obtain long life and continuous operation with a minimum of attention when installed in industrial plants for connecting motors to machines or lineshafts.

Marketing and Distribution

Advertising

Advertising Is Finding Itself. 659.13
G. Lynn Sumner. *Trained Men,* April 1925, pp. 75-77. Some valuable suggestions for obtaining better results from advertising by the president of the Association of National Advertisers.

The Envelope—Another Overlooked Advertising Asset. 659.13
C. B. Larrabee. *Printers' Ink Monthly,* April 1925, pp. 27-29. Illus. Suggestions for the use of envelopes as effective advertising mediums.

How We Chart Returns from Our Direct-Mail Advertising. 659.1
Robert L. Blanchard. *Printers' Ink Monthly,* April 1925, pp. 30-32, 109-110.

Illus. A simple system of graphic charts for furnishing a specific answer to the question, "Does our advertising pay?"

Illustration in Advertising. 659.13
W. Livingston Larned. McGraw-Hill Book Company, New York. 321 pp. $4.00. Illus. A complete discussion of all forms of art work as applied to illustrations for newspaper and magazine advertisements. It considers illustrations in their relation to copy, to the product, and to the psychology of the consuming public. A large number of reproductions of illustrations used in many advertising campaigns are given as examples of modern effective illustrative methods. This book should be of considerable value to everyone who is interested in advertising art work, whether advertising manager, copy-writer, artist, or business executive who directs his own advertising campaign.

Isn't It Time for Advertising to Drop Its Hocus Pocus? 659.13
Mac Martin. *Printers' Ink*, March 26, 1925, pp. 3-4, 6, 196. An evaluation of present-day advertising methods.

The Selling of Castings—IX. 659.1
Foundry Trade Journal, March 5, 1925, p. 201. Kinds of advertising, points to stress, keeping to facts, convincing arguments, meeting needs of market advertised in.

Testing the Value of Advertising Media. 659.1
Norman Hunter. *Sales Management* (England), February 15, 1925, pp. 78, 80. Methods to be used for making tests.

The Truth About a Business Has a Way of Getting Around. 659.1
John Hertz. *Advertising and Selling Fortnightly*, March 11, 1925, pp. 17, 50-51. The effectiveness of a company's advertising depends upon whether or not it truthfully reflects honest and intelligent management.

"Use of the Product" as an Industrial Theme. 659.13
Walter T. Dorr. *Printers' Ink*, March 12, 1925, pp. 81-82, 84. Industrial advertisements that show the product in actual service on a customer's premises are effective.

What the Eastern Farmer Reads. 659.13
Edward Erving Pratt. *Sales Management*, March 7, 1925, pp. 379-380, 416-417. Analysis of investigation of farm paper reading habits of group of farmers in 11 eastern states.

When Employees Double in Advertising Copy. 659.13
Dana Hubbard. *Printers' Ink*, March 26, 1925, pp. 81-82, 84, 88. Adding human interest to copy by using employees as material for ads.

Selling

Cutting the Cost of Distribution. 658.8
Alvin E. Dodd. *Trade Winds*, March 1925, pp. 3-4, 18-20. Illus. Discussion of problems involved with suggestions for information necessary before they can be solved.

Getting Profitable Business from Doubtful Credit Risks. 658.882
Robert M. Dulin. *System*, April 1925, pp. 469-472, 518. Illus. Methods used and results obtained by the Gates Rubber Company.

Hood Rubber Sales Budgets. 658.8
K. W. Stillman. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 417-420. Illus. Detailed explanation of methods used by Hood Rubber Products Company to budget their selling expenses and to establish and achieve sales quotas which will make operation of the selling department profitable.

How to Measure Your Market. 658.8
Fred Y. Presley. *System*, April 1925, pp. 455-459, 504-506. Illus. Positive measurement of profitable sales range enables an extensive direct-mail program to be followed with assurance that every campaign released would produce maximum returns at a minimum of misdirected effort.

How We Make Each Selling Hour Count. 658.85
T. O. Potter. *System*, April 1925, pp. 491-492, 494. Illus. Factory to user selling methods of the Fuller Brush Company from the retail standpoint.

Is Turnover in the Sales Force Really a Blessing in Disguise? 658.807
Sales Management, March 21, 1925, pp. 441-442. Is there a point of diminishing returns in salesmen's salaries where it is cheaper to fire than hire?

Law of Market Areas Explained. 658.8
Frank A. Fetter. *Iron Trade Review*, March 26, 1925, pp. 817-819. Illus. Formula evolved for determining progressive effect of freight rates on competitive conditions. Boundary lines between tributary territories are in forms of hyperbolic curves.

Managing the Automobile Sales Fleet. 656:658.8
H. A. Simons. *Cement, Mill and Quarry*, March 20, 1925, pp. 15-16, 18, 20. Illus. Use of 130 salesmen's automobiles enables the United States Gypsum Company to canvass customers thoroughly and assist dealers. Maintenance methods, and weekly and monthly reports on condition of cars and cost of upkeep are described.

More Horse Sense Needed in Hiring Salesmen. 658.807
Amos Bradbury. *Printers' Ink*, March 12, 1925, pp. 125-126, 128, 132. Simple application blanks supplemented by more hard-headed judgment would lower turnover.

The Qualities of a Real Sales Manager. 658.811
H. L. Carrad. *Sales Management* (England), February 15, 1925, pp. 72, 74, 76.

Salesmen Who Sell Themselves Rather Than the Line. 658.85
A. H. Deute. *Printers' Ink*, March 26, 1925, pp. 41-42, 44, 48. Difference between salesmen getting themselves "in right" with the trade and getting the line "in right."

Sales Methods Built Up the Fuller Brush Business. 658.85
H. R. Simonds. *Iron Trade Review*, March 26, 1925, pp. 809-812. Illus. Manufacturing and selling methods which have developed the industry.

Selling Knitted Garments Direct to Consumer. 658.83
Louis R. Keeffe. *Textile World*, March 21, 1925, pp. 43, 81. Development of direct-to-consumer marketing policy in mill originally selling jobbers exclusively. Difficulties and advantages.

The Selling of Castings—VIII. 659.1
Foundry Trade Journal, February 5, 1925, p. 121. Advertising—methods, advantages and results.

What Else Should a Salesman Be? 658.807
Roy Dickenson. *Printers' Ink Monthly*, April 1925, pp. 41-42, 121-123. Suggestions for salesmen's activities outside of selling effort with method used by Coca-Cola Co. for visualizing this field.

Shipping

Better Shipping Containers. 658.78844
Floyd T. Smith. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 421-424. Illus. Useful information and specific recommendations to secure better packages with particular reference to internal packing and bracing, and packing for export.

From Detroit to the Argentine; Steel Products Shipped by Boat. 382
Iron Trade Review, March 12, 1925, pp. 696-698. Illus. Traffic study, method of organization and operation, loading and unloading, and elimination of crates and boxes, in shipping Ford products.

Small-Consignment Commodity — Distribution in London and Its Environs. 656
James Patterson. *Journal of the Society of Automotive Engineers*, March 1925, pp. 326-329. Discussion of a paper presented before the society, and appearing in a previous issue, on transportation of freight in and around London.

Unit Containers in Freight Transportation. 658.78844
Railway Review, March 21, 1925, pp. 557-562. Illus. Development of the unit containers up to the present, interurban freight service, English and German types of unit containers, advantages of the system.

Material Handling and Production Control

Material Control

Effective Methods of Tool Control. 658.563
Anker L. Christensen. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 467-470. Illus. Organizing a tool room and the methods of handling, issuing and returning tools in the H. R. Worthington works.

How We Abolished the Requisition Nuisance. 658.784
B. Klugkist. *Factory*, April 1925, p. 593, 690-692. Illus. Description of the "double-check" bin tag system for storeskeeping, adopted by the Chicago Pump Company.

Inventory Practice and Material Control. 658.78
Frederic W. Kilduff. McGraw-Hill Book Company, New York, 446 pp. $5. Illus. Income tax requirements and the great increase in the investments in inventories have made them a subject of much importance to manufacturers. The first section of this book describes in detail the essentials of complete physical inventories from the planning to the tabulation of the results. The second part is devoted to the procedure necessary to efficient, exact, and satisfactory material control. The book describes all forms and schedules required and includes a discussion of the income and profits tax laws, in relation to inventories, from the 1913 law to and including the 1924 law.

Methods Which Keep Inventories at a Minimum. 658.787
Willard J. Graham. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 471-474. Organization of the General Inventory Control Department of the Liquid Carbonide Company. Also the simple methods whereby this department oversees the inventory of both plants and sales branches.

Right Material; Right Place; Right Time. 658.78
W. H. Fleming. *Factory*, March 1925, pp. 438-441, 530, 532, 534. Methods of the Goodyear Tire and Rubber Company in controlling the quantities of material.

The Storage and Handling of Fuel Oil in Industrial Plants. 658.78
Mechanical Engineering, April 1925, pp. 272-274. General information in regard to satisfactory methods for storing and handling fuel oil.

Mechanical Handling

Straight Line Methods of Handling. 658.281
Matthew W. Potts. *Industrial Management*, March 1925, pp. 157-162. Illus. Application of equipment to production in the bakery of the H. C. Bohack Company.

Recent Mechanical Chargers for Blast Furnaces. 651.76
J. M. Ringquist. *Iron and Coal Trades Review*, February 20, 1925, pp. 293-295, and 313-316 for illustrations. Bucket system and hoisting mechanism, "vertical-horizontal" chargers, size, methods and speeds of operation, and advantages.

Material-Handling Pay-Roll Reduced 75 Per Cent. 658.281
Maxwell C. Maxwell. *Factory*, April 1925, pp. 594-598. Illus. Outline of methods for using the industrial truck. Fundamentals applied are: adapt the equipment to the work it must do; schedule the day's work of each truck. The practice is drawn from the Yale and Towne Manufacturing Co.

Haulage—XIII. 621.86
Adam Crawford. *Coal Mine Management*, March 1925, pp. 41-52. Illus. Haulage wire ropes, their structure, lay, fittings, methods of attachment, splicing, lubrication, etc.

Handling Equipment Facilitates Straight-Line Flow of Work. 658.281
Mark Wayman. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 425-428. Illus. The new building of the *San Francisco Chronicle* is laid out for mass production of newspapers along straight-line flow and through the extensive use of material-handling equipment.

The Conveyance of Material in the Foundry. 658.281
J. M. Primrose. *Foundry Trade Journal*, February 26, 1925, pp. 188-189. Demands of various sections, sand handling, transportation, economies effected.

Aerial Tramway Removes Ashes from Windsor Power Station. 658.281
T. Thorsten. *Power*, March 10, 1925, pp. 364-367. Description of a cableway over a mile in length which, in connection with a belt conveyor, storage tank, and loading device, disposes of ashes from a power station. The system has a capacity of 100 tons per hour operating 40 buckets at a traveling speed of 400 ft. per min.

Production Methods and Control

Continuous Production. 658.5
Frank G. Woollard. *Engineering Production*, March 1925, pp. 83-87. Illus. Description of plant layout and production methods of Coventry plant of Morris Engines, Ltd., where continuous production of automotive products has been achieved.

How They Took the Five Steps to Successful Inspection. 658.562
W. E. Irish. *Factory*, March 1925, pp. 417-419. Methods used by The Erie City Iron Works to reduce errors, inferior product and spoilage. A constructive type of inspection methods.

Improvements in Heat Treating Equipment. 651.76
Arthur L. Green. *Forging—Stamping—Heat Treating*, March 1925, pp. 84-86. Illus. Accuracy and uniformity of product assured and economies in process brought about.

Layout and Most Economical Use of Metal Strips and Sheets, Especially for Round Punchings. 658.51
(Aufteilung und Ausnutzung von Bändern und Tafeln, Inbesondere für Runde Ausschnitte.) J. Schroeder. *Werkstattstechnik*, February 15, 1925, pp. 121-130. Illus. Use of strips of ideal and of given width. Tables, equations and charts of use factors.

Making Better Crates—and in Half the Time. 674.61
B. E. Gaylord. *Factory*, April 1925, pp. 602-605. Illus. Shows method of using the jig to build shipping crates.

Methods of Repairing Steel Cars. 658.58
George P. Hoffman. *Railway Mechanical Engineer*, March 1925, pp. 153-154. Illus. Unit spot system of repairing steel cars is practical, economical and time-saving.

New Methods in Manufacturing. 338
(Neue Wege zum Fabrikationserfolg.) Georg Schlesinger. *Zeitschrift des Vereines Deutscher Ingenieure*, February 21, 1925, pp. 197-206. Illus. Review of Dr. Schlesinger's investigation of American industry, including construction and arrangement of plants, machinery used, standardization, management methods, and specific industries.

One Machine Per Man Per Day. 658.5
E. F. Ross. *Iron Trade Review*, March 19, 1925, pp. 745-748, 752. Illus. The Foote-Burt Company applies production methods of automobile industry to washing machine department.

Planning. 658.51
R. O. Herford. *The Cost Accountant*, February 1925, pp. 303-311. Necessity for planning operations, some methods of accomplishing it, and its effect on manufacturing costs.

Possible Economies in Automotive Machine-Shop Operation. 658.5
A. L. DeLeeuw. *Journal of the Society of Automotive Engineers*, April 1925, pp. 460-464. Illus. Discussion of a paper appearing in the November 1924, issue of the Journal.

Production Control. 658.5
George D. Babcock. *Mechanical Engineering*, April 1925, pp. 243-248. An outline of production control in manufacturing, considering actual output with given equipment; preplanning, establishment of manufacturing programs, determination of lot sizes, operation analysis; stores systems, dispatching, inspection and maintenance.

Time Setting in a Machine Tool Plant. 658.542
Myron A. Lee and Dwight Vandevate. *Industrial Management*, March 1925, pp. 152-156. Illus. Methods used and calculations made in the Gleason Works, where wide variety and small quantities made individual time studies impracticable.

Time Study. 658.5421
Engineering Production, March 1925, pp. 89-91. Charts. Outline of procedure for making time studies and analyzing and applying the results obtained.

Employment and Personnel Management

Employment and Training

Foundry Apprentices. 658.386
P. S. Russell. *Foundry Trade Journal*, February 12, 1925, pp. 139-142. Foundry working conditions, opportunities for advancement, successful apprenticeship schemes, procedure in training, educational systems, making foundry employment attractive.

Personal Data and Vocational Fitness. 658.312
Donald A. Laird. *Industrial Management*, March 1925, pp. 163-172. Illus. How to analyze the relationships between fitness and specific traits, characteristics, and mental equipment.

What Is a "Skilled" Man? 658.31255
Merrill R. Lott. *Industrial Management*, March 1925, pp. 179-182. Illus. A suggestion for a better method of analysis of men and jobs.

Personnel

An American Experiment in Unemployment Insurance. 658.3151
Bryce M. Stewart. *International Labour Review*, March 1925, pp. 318-328. Eighteen months' working of a plan established by voluntary agreement between employers and employees in the men's clothing industry of Chicago.

Computation of Labor Turnover. 658.3126
Paul F. Brissenden. *American Management Review*, April 1925, pp. 114-116. Derivation of simple formulas for use in determining labor turnover.

Factory Work's Effect on Employees. 658.31
W. H. Stewart. *Michigan Manufacturer and Financial Record*, March 7, 1925, pp. 3, 22. Modern methods help workers in physical, mental and financial ways. Use of machinery has made the factory employee more of a brain worker.

The Functions and Possibilities of Works Councils—III. 331.15
Eric N. Simons. *Mechanical World*, March 6, 1925, pp. 152-153. Discussion of type of subjects that may properly be considered by the works council.

The Labour Department and Its Functions. 658.315
Eric N. Simons. *Mechanical World*, March 27, 1925, pp. 201-202. Necessity for and responsibilities of a department in each plant that is devoted to forwarding friendly relations between management and men.

The Principles Involved in Securing Service Ratings as Exemplified in a Large Bank. 658.3113
Forrest A. Kingsbury. *Public Personnel Studies*, March 1925, pp. 70-84. Charts. Details of a successful method for determining employee ratings which is applicable to many other types of business.

Undesirables Keep Out! 658.314
L. M. Stowell. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 437-438. Methods of organizing crew of watchmen and system of identification badges for the protection of plant property and goods.

Women Trade Unionists in the United States. 331.88
Amy G. Maher. *International Labour Review*, March 1925, pp. 366-380. While legislation has been the main method of securing better working conditions for women in industry, organization, particularly in the clothing industry, has accomplished improvements, as explained in this article.

Safety

Sustained Interest Key to Safety Success. 658.3823
Carl B. Auel. *Iron Trade Review*, March 19, 1925, pp. 756-758. When and what to inspect, methods of keeping the question alive, the 10 commandments of safety.

The Safety Meeting at Fisk, That Never Adjourned. 658.3823
George Earl Wallis. *National Safety News*, April 1925, pp. 5-9. Safety promotion methods in use at the Chicopee Falls plant of Fisk Rubber Company.

Safe Handling and Use of Cutting and Welding Gases. 658.3823
G. O. Carter. *Acetylene Journal*, March 1925, pp. 429-432. Prevent accidents by proper methods of transportation, storage, and use.

Essential Requirements of Safety Switches. 621.3
J. Elmer Housley. *Industrial Engineer*, March 1925, pp. 123-126, 161. Illus. Elimination of the wooden panel, box and support has reduced fire hazard. Ten features which are necessary to make the switches operate well under all conditions, and easy to maintain.

Wages

A Plan for Analyzing the Worth of An Occupation. 658.3215
Merrill R. Lott. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 451-455. Charts. Detailed description of methods by which relative wage rates in different occupations can be placed on a scientific basis as satisfactory to the workmen as to the management.

Some Precedents for the Family Wage System. 331.2
Paul H. Douglas. *International Labour Review*, March 1925, pp. 353-365. Grading remuneration according to need of the family allowance system is not new and bids fair to alter appreciably present methods of wage payment.

Unemployment and International Wage Rates in Engineering. 331.2
Hugh Quigley. *World Power*, March 1925, pp. 122-127. Illus. Problems formerly thought to be theoretical economics, but which are now of real industrial concern.

Financial and Accounting Control

Accounting and Cost Finding

Time and Wages With Notes on Allocation. 657.452
P. A. Lightbody. *The Cost Accountant*, February 1925, pp. 289-291.

A Suggestion for Cost Accounting. 657.452
Paul K. Guillow. *Industrial Management*, March 1925, pp. 174-178. Illus. Distributing departmental burden in a furniture factory on the basis of actual process hours.

A "Reasonable" Cost Plan That Safeguards Profits. 657.452
System, April 1925, pp. 475-476, 546-550, 552. Illus. How the Buda Company obtains accurate costs on thousands of parts and hundreds of completed products with very low clerical labor and expense.

Knowing Better Than Guessing. 657.452
Iron Trade Review, March 26, 1925, pp. 813-816. Discussion of the uniform cost system developed for the structural steel industry through the American Institute of Steel Construction, with table of a complete cost.

Cost Finding in the Garment Industry. 657.4521
C. G. Daughters. MANAGEMENT AND ADMINISTRATION. May 1925, pp. 443-446. Charts. Detailed explanation of a simplified system, adaptable to a wide variety of small industrial plants which permits accurate determination of costs with very little paper work, in addition to keeping usual original records necessary.

Financial Control

Good Will and Its Valuation. 657.4236
A. C. Ernst. *Printers' Ink*, March 19, 1925, pp. 3-4, 6, 8, 125-126, 128, 131-132, 134, 137-138, 140. There are many factors that influence the determination of the value of good will. They are discussed in this article from the taxpayer's viewpoint as well as from that of the business needs.

Financing the Young Manufacturing Business. 658.14
E. M. Sims. *Factory*, April 1925, pp. 584-585, 620-628. Illus. Steps taken by the Metal Forming Corporation to secure additional capital for operation and expansion. An important factor is contact with commercial bankers and giving the banker full and complete information in regard to business operations.

Financing Domestic Automobile Sales. 658.882
C. C. Hanch. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 475-480. Illus. Methods of increasing sales by extending credit through dealers to consumers, and procedure followed for the protection of the manufacturer.

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MANAGEMENT
AND
ADMINISTRATION
IN MANUFACTURING INDUSTRIES

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Management's Attack on Waste*

By GERARD SWOPE

President, General Electric Company

ELIMINATE industrial waste! Minimize industrial controversy! We all agree upon the desirability of realizing these two ideals, but do any of us know how we can do so? Employers, as they look backward, recognize that the responsibility has been theirs and is largely theirs today, and if we look back I am sure most of us will agree that we wish it had been better done. It is largely because management did not see this problem clearly that many of the difficulties in industrial organization have since arisen.

It seems to me that the question is always this: We agree with the principles, but what are we going to do about the problem? How are we going to go about it? How are we going to apply the principles in industry?

Gerard Swope

Of course, there will never come a time when industrial waste will be entirely eliminated. This would be the counsel of perfection and is impossible of attainment. There is no question in my mind that industrial waste can be greatly reduced, and that as management becomes more alive to the problem, its solution will be more nearly attained. One of the great efforts of management today is to see that this problem is recognized not only by the supervisory organization but also by the employees. If the understanding, sympathy, and co-operation of each member of an organization can be secured, there is much greater hope for a nearer attainment of the goal—the elimination of industrial waste.

We have a great advantage in America in having a large population becoming constantly more homogeneous, speaking one language, existing under the same political institutions, having common ideals and a high standard of living. This makes it possible to market a standard product, bringing in its train the advantages of quantity production, in which field the manufacturing companies throughout the United States have taken the lead.

The problem still before us is to reduce selling prices so as constantly to reach a larger and larger circle of buyers, and this means not only the advancement in manufacturing processes but also reductions in cost so as to enable us to distribute this product at a lower selling price. Reductions in cost do not necessarily mean increased profits to the manufacturer; they may to a certain extent, but lower costs must sooner or later be reflected in lower selling prices to the public. This, as we learn from experience, is a fact, and a fact which, from the standpoint of the manufacturer, is very desirable, since the market is thereby enlarged, with the possibility of still further reducing the manufacturing and distributing costs.

Nor do lower selling prices and lower costs mean

* Delivered before the National Civic Federation.

lower earnings for the workmen. It is quite consistent with lower costs to have increased earnings on the part of the workmen. This has been demonstrated in the electrical industry as well as in a number of other industries. As an example, the incandescent lamp is today selling at lower than pre-war prices—and there are not many articles in common use about which this can be said—while at the same time the labor content in the lamp itself has been reduced, and the earnings of the people engaged in the manufacture of incandescent lamps have increased upwards of 100 per cent.

Value of the Suggestion System

A most useful method not only of eliminating waste and introducing better methods, but also for improving the morale of the organization, is the suggestion system—inviting and encouraging the workman at the bench to make suggestions for improved methods. In using this system it is essential to see that each suggestion is carefully considered; that the man who made the suggestion knows that it has had mature and fair consideration; that, if adopted, the contribution is recognized by the company publicly and in a substantial way, commensurate with the contribution made; and that the man's associates are informed of his success.

The effect upon the organization, of these suggestions by workmen, is of even greater importance than the reduction in cost to the company and the monetary rewards to the men. The men themselves are stimulated, and the *esprit de corps* of the organization as a whole is strengthened through the recognition that the workman is a live, integral part of the business, able to contribute to a greater extent in its upbuilding. This gives the workman a greater interest and keener sense of enjoyment from his work, as he feels that he has made a constructive contribution, and that the recognition that has come to him not only is appreciated by him, but also has made him more respected by his associates.

Finding the Exceptional Man

This often leads to finding talent and ability for bigger jobs. This is one of the most difficult and elusive parts of the problem of management—finding the exceptional man. It is a very wide-spread problem, and one which is especially pressing in any large industrial organization. The problem of knowing and rating the men, and giving them opportunities to do bigger jobs, is essentially a job for management.

But probably the most tragic waste of all in industry is unemployment, where men ready and willing and able to work, whom society really needs, are still unable to secure it. The most severe test of any social system is the consideration it gives to the human being, and our present system must find a solution of this great human problem.

Industry also is much more cordial today than ever before toward the problem involved in minimizing industrial controversy. It is recognized that if the sympathy and understanding of the workmen is gained, the spirit of an organization will be much better, work will go more smoothly, the material results accomplished will be greater, and the human satisfaction to all concerned will be vastly increased.

As business is organized today, most companies have a large number of shareholders, to whom they report periodically the results of operations, and there is every reason why the workmen should be kept informed of the development of the business so that they also can see whither it is tending. This has been accomplished in many instances with marked success by having the representatives of the men meet with the management for the purpose of discussing various problems as they arise, so that the men will have a general understanding of the business of the company. One of the gratifying results has been the increased satisfaction on the part of the workmen, which has been one of the causes of the largely decreased turnover of labor.

There is still much to be done, and the most hopeful aspect of the problem is that management and men are approaching it more open-mindedly.

Progress in Simplification

A RECENT bulletin issued by the Division of Simplified Practice of the Department of Commerce contains strong evidence that American manufacturers are becoming thoroughly convinced that simplification is distinctly a worth-while pursuit. Constantly, new industrial groups are seeking government assistance in reducing varieties of their products, and groups that already have simplified their output are returning with plans for eliminating still more varieties.

A brief review of the simplification projects now in progress gives a clear picture of the great extent of this movement.

The milling cutter industry has informally approved a 35 per cent reduction of varieties. The sheet metal ware industry, makers and users of dining car chinaware, the sterling silverware industry, and the shoe polish group have all reached the preliminary conference stage in simplification proceedings. The grocery paper bag industry is working toward uniformity of capacity for their products.

In the lumber industry a standardization program affecting soft woods is nearly completed, while standards for hard woods are being prepared. A single set of standards in the sash, door, and mill-work industry to replace widely divergent sectional standards is the aim of another committee. A survey is about completed covering short length lumber, and the office furniture industry is initiating a simplification program. In the distribution field, work being done by carton manufacturers is of great interest.

In addition to these new projects a number of industries are collecting data looking toward revision of simplification recommendations previously approved. Among these are: metal lath, paper, asphalt, files and rasps, range boilers, milk bottles and caps, bed blankets, and hollow building tile.

New Plant Eliminates Hand Labor

Standard Milling Company Installs Complete Material Handling System

By A. P. WALKER

President, Standard Milling Company

TO enlarge its facilities in the Metropolitan district The Standard Milling Company three years ago selected a new plant site located on the waterfront in Jersey City. On this site a six-story reinforced concrete building, Fig. 1, has been erected and is now ready for occupancy. Many features in regard to the new building, its location and the methods employed for the handling of material, are of interest from the executive standpoint.

Plant location for the greatest economy of distribution, and the design and layout of a new building for the greatest facility of operations, have become very complex problems requiring great care and forethought in their solution. Likewise, the selection of equipment, especially that for handling materials, which is the major operation in a great many enterprises, must be done not only to meet present requirements, but also to make sure that the systems adopted will render effective service over a long period of years, to conserve the large investment made in them. The new building just erected, combining the features of a flour packing plant and warehouse, is the result of very careful planning to insure the utmost economy along all of these lines.

FIG. 1 NEW PLANT OF STANDARD MILLING WAREHOUSE CORPORATION

The plant will be controlled and operated by The Standard Milling Warehouse Corporation, a subsidiary of The Standard Milling Company, which, through its various subsidiaries, operates one of the largest groups of flour and cereal mills in the world, including in their products the following nationally known brands: Hecker's Superlative flour, Ceresota flour, Aristos flour, Duluth Imperial flour, Hecker's cream farina, H-O oats, Presto (self-raising) flour, and other brands of flour and cereals. It will be used to pack flour of all kinds for the baking industry and for household use. It will also serve as the headquarters for distribution of these products to foreign ports, along the Atlantic Coast, and throughout the near-by territory.

The new building is located at the eastern terminus of the Erie Railroad, with which it is connected by sidings along the north of the building. On the south side it is bordered by Harsimus Cove, an inlet from the Hudson River. Along each end are platforms to serve delivery trucks. Thus the entire four sides of the building serve either as receiving or shipping stations. Shipments of bagged flour from the west are received directly by rail and, as necessary, may be sent out on lighters for export or coastwise water shipments, by truck for local deliveries, and occasionally by rail for large orders to inland customers beyond trucking distance.

The building is 378 ft. long and 87 ft. wide, and is divided midway down its length on each floor by a 6-in. concrete partition, thereby in effect separating it into two distinct plants connected by a doorway on each floor. One end of the building will be put into operation immediately and the other later on, but the material handling equipment is practically complete at present in the unoccupied end as well as in the part of the building to be actually operated. This equipment is almost identical throughout in both ends of the building. (See Fig. 2.)

Along the north side of the building are six tray elevators for handling individual sacks of incoming flour (see Fig. 3), and four electric freight elevators, manufactured by the A.B.See Elevator Company, for handling sacks which are stacked on platforms to be

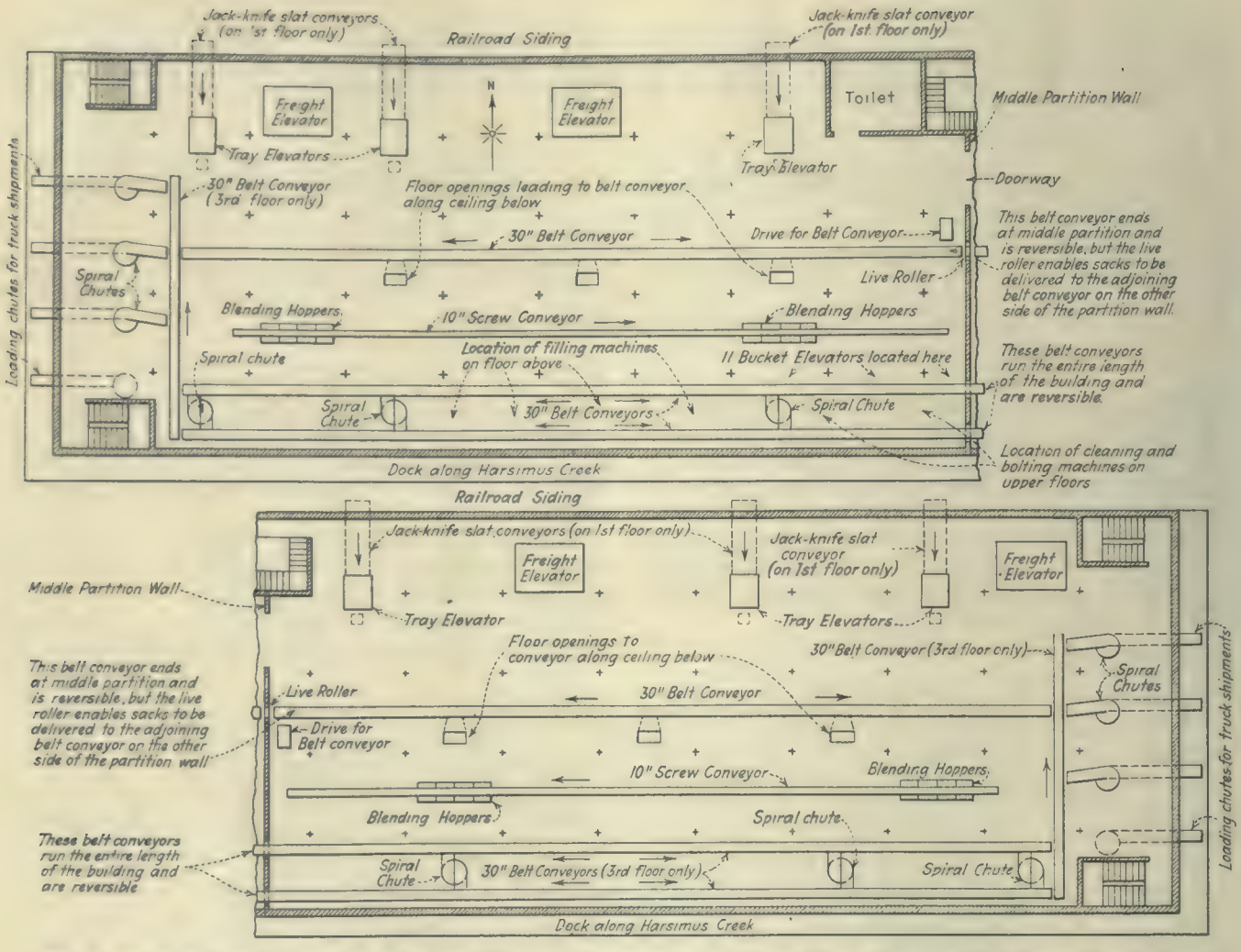
Jack-knife slat conveyors (on 1st floor only)
Railroad Siding
Jack-knife slat conveyor (on 1st floor only)
Freight Elevator
Freight Elevator
Toilet
Middle Partition Wall
Tray Elevators
Tray Elevator
Doorway
Loading chutes for truck shipments
30" Belt Conveyor (3rd floor only)
Floor openings leading to belt conveyor along ceiling below
30" Belt Conveyor
Drive for Belt Conveyor
This belt conveyor ends at middle partition and is reversible, but the live roller enables sacks to be delivered to the adjoining belt conveyor on the other side of the partition wall.
Spiral Chutes
Live Roller
Blending Hoppers
10" Screw Conveyor
Blending Hoppers
Spiral chute
Location of filling machines on floor above
11 Bucket Elevators located here
These belt conveyors run the entire length of the building and are reversible.
Spiral Chute
30" Belt Conveyors
Spiral Chute
Location of cleaning and bolting machines on upper floors
Dock along Harsimus Creek
Railroad Siding
Jack-knife slat conveyors (on 1st floor only)
Jack-knife slat conveyor (on 1st floor only)
Freight Elevator
Freight Elevator
Middle Partition Wall
Tray Elevator
Tray Elevators
Floor openings to conveyor along ceiling below
30" Belt Conveyor (3rd floor only)
Spiral Chutes
This belt conveyor ends at middle partition and is reversible, but the live roller enables sacks to be delivered to the adjoining belt conveyor on the other side of the partition wall
Live Roller
30" Belt Conveyor
Drive for Belt conveyor
10" Screw Conveyor
Blending Hoppers
Blending Hoppers
Spiral chute
Loading chutes for truck shipments
These belt conveyors run the entire length of the building and are reversible
Spiral Chute
30" Belt Conveyors (3rd floor only)
Spiral Chute
Dock along Harsimus Creek

FIG. 2 DIAGRAMMATIC LAYOUT OF MATERIAL HANDLING EQUIPMENT ON THIRD FLOOR, SHOWING ITS GREAT FLEXIBILITY

Layout of equipment on other floors is similar, except for the two long belt conveyors on the dock side, and the cross conveyors at the end.

moved by lift-trucks. Most of the handling, however, will be done by the tray elevators.

Each of these tray elevators has a jack-knife, slat conveyor which can be extended out into the box cars of incoming flour. When not in use, these slat conveyors, which are hinged at the middle and permanently pivoted at one end on the framework of the tray elevator enclosures, are raised out of the way, the front end folding partially down on the back end, after the manner of a closing jack-knife. The sacks of flour, weighing from 70 to 198 lb. each, are loaded by hand on the receiving end of these conveyors and are carried back and automatically deposited on the trays of the vertical elevator. (See Fig. 3.) The slats on the conveyors and the trays on the elevators are located at 6 ft. centers and are adjusted so that the conveyors deliver each sack of flour just at the correct time for it to be picked up by one of the trays. There are 29 trays on each elevator and they carry the sacks of flour to the floors above where they are unloaded.

It is necessary for each sack to go all the way to

FIG. 3 SLAT CONVEYORS CARRY BAGS FROM CARS TO TRAY ELEVATORS

FIG. 4 SCREW CONVEYOR FED FROM HOPPERS ON FLOOR ABOVE
Two systems like this are on each floor.

the top of the elevator and then descend on the far side to the floor where it is to be unloaded. By throwing a lever on the side of the casing on any floor, two rows of fingers are thrown into position to receive the sacks. These fingers alternate with corresponding fingers on the trays of the elevator, much in the manner of a grate, so that the tray passes freely down through the unloader while the sack is caught and discharged on a platform. Eventually the sacks will fall into chutes instead of on the platforms and will pass through a hopper to a belt conveyor running along the ceiling of the floor below, from which they will be unloaded either for use or for storage.

The elevators can be started or stopped by a control at the top floor, or by one to be installed on each of the floors below for the use of the man attending to the unloading.

On the up side of the elevator on each floor there is installed a loading device, consisting of fingers operated by a lever in a manner similar to that described above for the unloading mechanism. Hence, if it is necessary to transfer a quantity of sacks from, say, the fifth to the third floor, they can be carried on lift platforms to the nearest tray elevator, deposited, one by one, on the loading mechanism, picked up by the trays and carried over the top of the elevator and down the opposite side, landing on the unloading mechanism on the third floor.

Hand labor is thus eliminated entirely except for the placing of sacks on the slat conveyor at the railroad car, or on the elevator at any floor, and their removal to trucks or platform skids at point of delivery. The location of the elevators and of other handling equipment is shown in Fig. 2, which is a diagrammatic layout of the third floor of the plant. With the exception of the two belts traveling the entire length of the building, and the cross belts shown at the ends, the handling equipment is substantially the same on every other floor. The flour bolting and filling machinery, of course, varies on each floor.

The details of flour blending (for export shipment) and of the equipment used for the purpose would be of interest only to men engaged in milling operations. Consequently only a general outline will be given of the location and use of this part of the equipment, sufficient to indicate how it is tied into the general routing of material and is related to the handling equipment. Briefly, the flour as received at the plant comes directly from the mill and no further milling operations are required on it. But to fit the requirements of export trade, blending and repacking may be necessary. For this purpose 16 hoppers have been installed on each floor except the first, in groups of four, two groups in each end of the building, or a total of 80 for the plant. (See Fig. 2.) When a quantity of flour is to be blended, the proper number of sacks of each kind is dumped into one of these groups of hoppers, and falls through the four

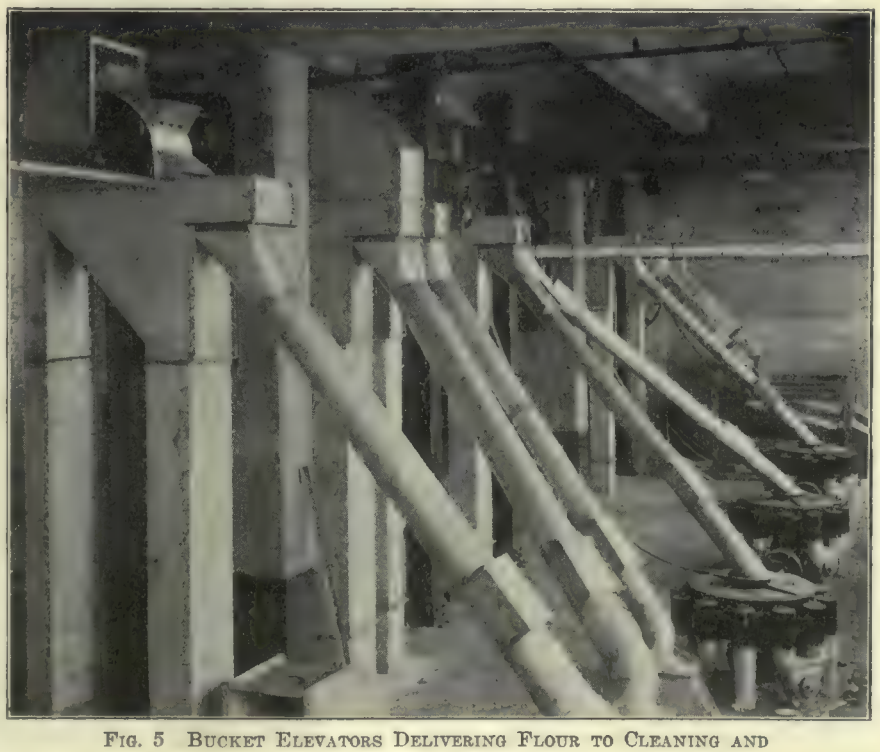

FIG. 5 BUCKET ELEVATORS DELIVERING FLOUR TO CLEANING AND BOLTING MACHINES

FIG. 6 FILLING MACHINES AND CONVEYOR BELT FOR FILLED SACKS

valves into a 10-in. screw conveyor running along the ceiling of the floor below, and enclosed in a casing. (See Fig. 4.) The location of this screw conveyor on each floor is the same and is shown in Fig. 2.

The flour is carried and mixed in this conveyor and travels toward the center of the building, where it falls down pipes and can be diverted, if necessary, into similar conveyors on lower floors. If it is not thus diverted it descends to the first floor, either into a trunk line conveyor there, which leads to the boot of a bucket elevator, or else directly into the boot of the elevator. This elevator carries it to the top of the building, where it passes through a cleaning machine to separate out any strings which may have fallen in from the sacks and then to a bolting machine which properly grades it. (See Fig. 5.)

From the bolting machine the flour is discharged into a mixer which completes the blending. This mixer consists of a three deck 10-in. screw conveyor about 40 ft. long. The flour travels the entire length of the upper deck, back through the middle deck, and then in reverse direction through the lower deck, and is discharged into large storage tanks over the filling machines.

These filling machines (see Fig. 6) have automatic weighing controls. A sack to be filled with flour is fastened, open-end up, in a sheet metal cylinder mounted on a platform of the filling machine. Above the open sack is the packing plunger, the two blades of which are each shaped like the parts of a two-wing propeller. As the flour falls into the sack this plunger packs it, the top of the metal cylinder meanwhile pressing against the cover to prevent spread of dust. The platform descends as the flour fills the sack, and the flow of flour shuts off automatically when the correct weight has been discharged.

The filled sacks are placed on a 30-in. canvass belt conveyor running along the floor in back of the filling machines. At the end of the line of filling machines there is an electric sewing machine and the open end of each sack is sewed shut by the operator stationed at this point. The sacks are then replaced on the conveyor and are deflected down a chute to the floor below. Here they are discharged onto belt conveyors running the entire length of the building. (See Fig. 2.) These conveyors can be operated in either direction. If it is desired to send the sacks to lighters for water shipment, deflectors placed at the proper points along the belts, which run along the south, or water side, of the plant, remove them and send them down any one of six chutes leading to the ground floor.

The discharge ends of these chutes are located opposite doorways giving access to the dock. (See Fig. 7.) They are equipped with swivel extensions so that the sacks can be sent in any direction over a radius of about 12 ft. A chute, or conveyor, leading to the barge receives the sacks and carries them aboard.

If the shipment is to be made by trucks, however, the deflectors along the two long conveyor belts are moved back out of position. The belt is driven in either direction, depending upon which end of the building the shipment is to leave. At each end are

FIG. 7 SWIVELED CHUTES TO DELIVER SACKS FROM UPPER FLOORS TO BARGE

FIG. 8 BELT CONVEYORS ALSO DELIVER SACKS TO A SECOND BELT SYSTEM WHICH CARRIES THEM TO THE SPIRAL CHUTES FOR TRUCK SHIPMENT

three spiral chutes running from the sixth to the first floor, and an additional spiral chute running from the third to the first floor. The three former in each case serve as the final media to carry to the trucks the sacks of flour from the two lines of belt conveyors previously described. These conveyors, for truck shipments, feed onto non-reversible belt conveyors running cross-wise of the building at each end, and traveling from south to north, or away from the other systems of belt conveyors. (See Fig. 8.) The sacks of flour are delivered to the cross conveyors, and deflectors placed along these conveyors at each of the chutes discharge the sacks into the spiral chutes down which they descend for shipment. The deflector on the last chute is, of course, stationary, while the other two can be operated from the floor, and either held stationary or moved in and out to take off selected sacks at the first or second spiral chute. (See Fig. 9.)

Sacks of flour which are broken open in transit or in handling around the plant, and which do not have to go through the blending process, nevertheless must go through a cleaning process before they are shipped. For this purpose there is a hopper on the first floor into which such sacks are emptied. The flour is taken up by bucket elevator and put through a reel, or cleaning machine, which removes any foreign matter. It is then delivered into a storage tank feeding a filling machine, and is handled in the same manner as described above for blended flour.

For the handling of sacks of flour from storage to point of shipment a system of belt conveyors is suspended along the ceiling of each floor except the sixth. (See Fig. 10.) These conveyors are shown along the center of the room in the diagrammatic layout of Fig. 2. Each conveyor is operated from the middle of the building, and each system is in two parts and can be run in either direction. If it is desired to carry sacks from one end of the building all the way to the other, a live roller mounted in the wall opening where the two separate belts adjoin will carry the sacks over from one belt to the other. Each belt is equipped with a take-up to maintain the tension and prevent slippage.

The system of belt conveyors just described for each floor is fed through chutes leading from hoppers in the floor above. These hoppers are flush with the floor line and are covered by floor plates except when in use. The system was devised to eliminate trucking and handling as far as possible. If a quantity of flour is to be moved from storage to shipment it is necessary merely to take up the nearest floor plate, and drop the sacks down through the chutes

FIG. 9 SPIRAL CHUTES LEADING TO TRUCK PLATFORM

FIG. 10 DRIVE END OF ONE OF THE BELT CONVEYORS ALONG THE CENTER OF EACH FLOOR

Chute from floor above leads to conveyor.

onto the belt conveyor along the ceiling of the room below, which carries them to the end of the building and discharges them down the spiral chute to the trucking platform. (See Fig. 11.) If the shipment is to go by water, it will be taken to the nearest spiral chute along the water side of the plant, six of these being located at convenient distances on this side of the building, and delivered to the lower floor by this means. Shipments by rail are rather rare but can be cared for either by the tray elevators or by loading platform skids onto the freight elevators and trucking them to the cars.

The equipment, of course, has been standardized throughout. All the belt conveyors are equipped with 30-in. stitched, 6-ply, paraffined, United States Rubber Company canvass belts. They are all reversible except the two cross belts on the third floor. There are 16 belt conveyor systems in the plant. The 18 spiral conveyors are all of the standard 10-in. size. Ten of them which run from the ends of the building toward the middle are each 140 ft. long. There are 12 loading points on the dock side and 4 at each end for trucks.

Electric drive has been used throughout. On the screw conveyors James transmissions are used and on the tray elevators Footes' transmissions are employed. All machinery is direct driven, except certain of the blending and filling equipment, which is operated from line shafts.

The building consists of 18 bays at 21 ft. centers, and is well lighted and ventilated throughout. It is thoroughly fireproof, no wood being used in its construction. The floors and walls are of concrete and the windows are Fenestra steel sash with wire glass.

All of the doors leading to stairways and from one end of the building to the other are fire-resistant and are weighted and equipped with fusible links, so that they will close automatically in case of fire. Likewise, all openings for the passing of belts through the partition walls, all the openings to tray elevators, and all the spiral chutes are equipped on each floor with weighted gates held up by wires and fusible links, which will melt and drop the doors when acted on by heat from a fire. A complete sprinkler system is installed on each floor. Each freight elevator is equipped with safety doors for protection to both life and property. All conveying systems are either enclosed or else out of the way of workmen, so that accidents have been made practically impossible. The fire insurance rate on the building is the lowest in New Jersey.

The plant is steam heated, the steam being purchased from outside. Current for lighting and power is likewise purchased. The unoccupied portion of the building will for a number of years be used as a storage warehouse for products of manufacturers who wish a convenient outlet for shipments by rail, truck, or water, and who desire these facilities at a minimum of handling charges.

The building was designed by the A. E. Baxter Engineering Company and the material handling equipment described in this article was designed, constructed and installed by the Weller Manufacturing Company.

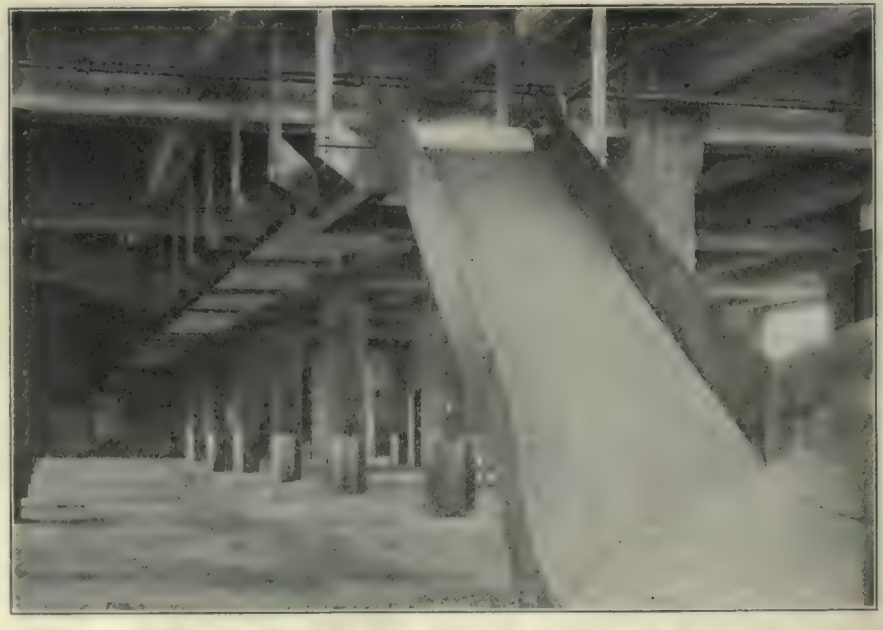

FIG. 11 DISCHARGE END OF ONE OF THE BELT CONVEYORS ALONG THE CENTER OF EACH FLOOR

Sacks are delivered to a spiral chute leading to truck platform.

Why Workers Choose Jobs

Interest and Ambition Shown to Be Strongest Appeals in Industry

By DOUGLAS FRYER

Assistant Professor of Psychology, New York University

THE final test of an industrial incentive or appeal is obviously—does it produce results? But sometimes this ultimate test requires months or even years, and in the meantime a great deal of money and effort may be wasted. Therefore, preliminary studies in industrial appeals, such as the one described here, may prove to be even more valuable than experiments with advertising appeals, which have had considerable scientific study.

In the study of industrial incentives, the first information necessary is an all-inclusive, or nearly inclusive, list of possible appeals, and these can be derived from psychology. Appeals to sexual and nutritional activities, to ambition for power and honor, to interest are among those which would be generally accepted as applying to human beings in general. The preliminary analysis of these appeals becomes a part of the experimental program of industry.

But what concerns the industrial manager most directly is not this complete list of appeals but the relative value of such appeals, the "pulling power" of each. To obtain a measure of the effectiveness of appeals, it is necessary to go to the workmen themselves. With this purpose of determining the relative pulling power of various general appeals, a sampling was made of adult male applicants at a New York employment exchange during the period 1920-23. Five hundred and thirteen individuals between the ages of 16 and 58 (median age, 23.8 years, middle 50 per cent 21.1 to 27.3 years) were asked to indicate the foremost reason or reasons influencing them in the choice of an occupation, it being considered that in these reasons would be found the appeals most potent for the worker.

The eight general appeals below were presented to the men composing the sample, who were asked to check one or more as influencing them in choice. A place at the end of the list was given for remarks, but this was not used by the workers to add further reasons. The workers checking these appeals represented more than 100 different occupations. In general intelligence the mode for the group was somewhat higher than that found for the Army draft.

CHOICE OF OCCUPATION

A. Because of *interest in it;* liking and enjoying the work for its own sake.
B. Because of *ambition;* desire for influence, power, or the opportunity for success.
C. Because of *advantages accompanying the occupation*: that bring you into a group or neighborhood you like, etc.
D. Because of a *sense of duty;* service to God, humanity, community or nation.
E. Because of *fitness;* educated and trained for work.
F. Because of *financial reasons;* good money or great profit.
G. Because of *family traditions;* father did it, family expects it, etc.
H. Because of *necessity;* nothing else to do.

One thousand and seventeen reasons were selected by these 513 individuals as motivating them in their choice of work, approximately two to an individual. In the analysis of these reasons, each will be considered of equal weight. Checking of those which appeal most would seem, with an untrained group of judges such as those composing the sample, to offer higher reliability than a requirement of rating the entire eight.

Analysis of the Replies

Table 1 distributes the results in number and per cent for the eight general appeals. Marital status is given in this table, 20 per cent of the sample being married.

TABLE 1. STRENGTH OF INDUSTRIAL APPEALS—CHOICE OF WORK

Reasons	Total		Married		Single	
	No.	%	No.	%	No.	%
A. Interest	278	27	63	29	215	27
B. Ambition	302	30	56	26	246	31
C. Advantages accompanying occupation	89	9	12	6	77	9
D. Sense of duty	110	11	29	13	81	10
E. Fitness	106	10	27	13	79	10
F. Financial reasons	72	7	14	7	58	7
G. Family tradition	12	1	2	1	10	1
H. Necessity	48	5	10	5	38	5
Total group	1017	100	213	100	804	100

In the list, B, ambition, shows the strongest pulling power, 30 per cent voting for this. A, interest, follows next with 27 per cent. C, advantages accompanying occupation, D, sense of duty, and E, fitness, appear each to be only about one-third as strong as the leading motives of ambition and interest, while G, family tradition, appears quite negligible, and H, necessity, to have but slight influence.

The rating of financial reasons (F), which is found to be about one-fourth those of ambition or interest, is in harmony with the opinion advanced by R. B. Wolf and other industrial engineers as to the insufficiency of the financial appeal to work, given a living wage. It would seem that the financial appeal becomes less

and less significant above the point of bare subsistence. The appeal of good money and great profit appears here as less effective by several times than the appeals to satisfaction in the occupation itself and success arising from it. Here an important distinction may be observed between the money reward, as it stands alone, and the total reward of success as a sum of many features. In connection with the low rating of the financial appeal, it may be noted that most of the men studied were out of work, which fact might have been expected to lend unusual prominence to the financial appeal. To check upon the value of this appeal, the following questions were put to the men:

Which would you choose? (Mark one answer)

J. The job that pays little but gives work you would enjoy doing all your life.
K. The job you dislike but which pays the most money.
L. The job that pays a living wage and gives you work you enjoy.

RETURNS

J	64	13 per cent
K	22	4 " "
L	406	83 " "
Total	492	100 " "

The overwhelming majority here choose L. Of those choosing J, 80 per cent were single, 20 married; of those choosing K, 82 per cent single, 18 married; of those choosing L, 81 per cent single, 19 married. The median age for those choosing K was one year less than those choosing J (median ages: J, 24.2; K, 23.3; L, 23.8). Figures for K are too small to make deductions safe, but it is at least suggestive that the married men and the older men are, contrary to what might perhaps be expected, not found favoring K.

At the conclusion of this question the men were asked for remarks. Some of these remarks are given as indicating the content of the workers' mind and the manner of their thinking.

Remarks of those choosing J: The job that pays little but gives work you would enjoy doing all your life.

1. Happiness comes before money.
2. I have so far made some sacrifices in order to do the work I enjoy and think I will continue to do so.
3. I believe I can make the job I like pay well.

Remarks of those choosing K: The job you dislike but which pays the most money.

1. For the sake of my wife.
2. Because of need to support family.
3. Working for pleasure is hardly conceivable, but for subsistence highly essential.

Remarks of those choosing L: The job that pays a living wage and gives you work you enjoy.

1. It pays a living wage and gives me work I like. What more could one want?
2. If you have a good position and a fair wage you have nothing to worry about.
3. To give the best service one must enjoy his work.

Returning to the original problem of strength of working appeals, it is interesting to study the effect of various factors upon the men's choice. For those of elementary school graduation, more voted for A, C, F, and H, and less for D, E, and G, than might have been expected. For those having two or more years of high school, B. D, and G are favored, while C, F, and H are correspondingly slighted. Among high school graduates C, D, E, and F receive more votes than their average entitles them to. Figures are small, however, and differences inconclusive, so that there does not appear to be much educational influence upon the choice of appeals. Elementary school graduates tend toward A, and those of two or more years of high school to B.

Religious affiliation shows no striking effect. Catholics give a slightly higher per cent for B, ambition, and D, sense of duty; Protestants give slightly higher per cent for A, interest, and C, advantages accompanying the occupation. Jews show a distinctly higher per cent for G, family traditions, and H, necessity, while Catholics also show a higher per cent voting for G, family traditions.

In the matter of age, those voting for D, E and H have an average age of a year higher than the average for the entire group, while those voting for A and F are slightly older. Those voting for G are on the average a year younger than the average for the group. Those voting for A and B are seven-tenths of a year apart, B, ambition, below the average 0.4, and A, interest, above the average of 0.3. Marital status seemed to influence the voting very little except in the consideration of E, fitness. Married men who are older seem to consider fitness of great importance, while this is not true of single men to such a degree.

Conclusions from the Study

In this investigation of the effectiveness of industrial appeals the following tentative conclusions have been reached:

1. Based on a list of possible industrial appeals, the following eight appear, on *a priori* grounds, important: Interest; ambition; outside advantages; duty; fitness; financial reasons; family traditions; necessity.

2. Quantitative results show that the interest motive (manipulation or intrinsic interest in the work) and the ambition motive (superiority or the desire for honor or power) are by far the strongest industrial appeals. They are superior by three times to the appeals to altruism (duty) or training (fitness) or to the miscellaneous advantages accompanying the occupation, which rank, however, significantly higher than any of the other appeals in the list.

3. Among these workers, the financial incentive to work is found to be of minor value as an industrial appeal. It is less than one-fourth as significant as the appeal to ambition. This result is in line with certain opinions that have been advanced in the field of industrial psychology.

4. Possible outside factors, such as religion, education, age and marital status show slight, but not significant, influence upon the strength of these appeals for the individual worker.

Southern Furniture Plants Apply Modern Management with Success

Developing Organization and Fixing Responsibility Are First Steps

By CHARLES F. SCRIBNER

Management Engineer

MANAGING a furniture plant today cannot be conducted along the simple lines of a preceding generation. The industry has evolved a keen and wide-spread competition, and Southern furniture manufacturing is no exception to this competitive spirit. To meet this competition intelligently, all of the elements which comprise it must be recognized, analyzed, recorded, and definitely controlled.

The chief executive who is continually saying: "That's all right for the other fellow, but my business is different," and who is employing the management methods of a past decade, is the greatest trouble of the average small plant today. His progressive brother, making full use of the best of his own experience, plus all he can gain from the experience of others, has little time to worry about competition and thinks less of some other business as offering more opportunity for profit than the one in which he is engaged.

If this executive will lay aside his ideas of system gained from the bookkeeper-accountant, his conception of scientific management as a mass of ruled and printed forms, and his prejudice against the acceptance of things outside the realm of his personal experience, and will give careful, considerate thought to the principles which are involved, he will see that they are as practical and applicable in his plant and on his own work, as they have been for the "other fellow's" business.

Definition of Principles

The Century Dictionary defines a principle as "a fundamental truth; a set rule of action; a source from which anything proceeds; a law from which others may be derived or on which others are founded." Accepting this definition, let us see what the principles of modern industrial management are, and how they apply to manufacturing of furniture and other wood products.

As developed over a period of years, and in terms that will show their practical application to industrial problems, these principles may be stated as follows:

1. *Organization* must be devised for the most economical and profitable carrying on of the various functions of a business.
2. *Objectives* must be clearly defined and definitely understood as to sales, production, and profits.
3. *Control* must be exercised to supply the materials needed; to provide the labor required; and to insure the production defined as the objective.
4. *Standards* must be established which will break down the objectives into well-defined tasks for individuals, departments, and the plant as a whole.
5. *Rewards* must be set for attainment of the standards, and they must be made so operative as to provide incentive for reaching the objectives.

There are a number of elements relating to the principle of organization which experience has proved are not always given sufficient consideration in organizing a business for maximum profit.

In an industrial enterprise, organization is the primary principle because it is the most important factor leading to progress, production, and profit. As an enterprise grows and expands, it becomes more necessary that the chief executive delegate functions to others and depend upon his subordinates for the accomplishment of these functions.

The practical application of the principle of organization then calls for the following:

(a) A clear-cut distinction between the organization of ownership and organization for operation.
(b) Planning the organization machine on straight-line principles, to eliminate waste and lost motion.
(c) Defining the necessary functions which are required for the successful and profitable operation of the business.
(d) Delegating responsibility and the necessary authority for each function to make that responsibility effective.
(e) Training subordinates to use their knowledge, skill, and ability fully in the operation of the business.

For every business enterprise there must be an objective—a purpose. This purpose must be clearly defined, must be definite, and must be expressed in such terms that it will be easily understood as applied to the daily tasks of everyone in the organization, from the general manager to the floor sweeper.

Application of the principle of objectives then calls for the following:

(a) The sales objective, for each line produced and for each territory covered, must be determined.
(b) Present potentiality for plant output must be determined and recorded.
(c) Objectives as to inventories, expense factors, and profit margins, must be carefully determined.
(d) The foregoing objectives must be correlated in their actual workings.
(e) Actual results must be currently measured against the master program and its objective subdivisions.

Unless all factors of a business are under organized control of the chief executive, that business cannot make maximum progress and profit, because some phase of the business is bound to get away from him.

This organized control is not a matter of personal ability. It is a tool which assists in guiding personal ability in the scientific method as applied to industrial management.

Application of the control principle to an industrial enterprise calls for the following:

(a) The material supply must be assured to prevent production delays due to shortages.
(b) Workers must be available when needed for performance of each division of the master program.
(c) Orders—shipping and production—must be available, to keep capital and material investment employed and workers on the job.
(d) Executive decisions must be based upon facts, not on guess and gamble, to insure correct decisions.
(e) The foregoing factors must be co-ordinated, failures must be instantly reflected, and executive attention must be prompt in applying corrective measures where needed.

The establishment of standards means the adoption of specific methods or means by which to accomplish a definite result. By such standards quality, quantity, performance, value, and service are measured, gaged, or determined, and the best practice of an industry turned into definite form for practical use.

Applying the principle of standards to industry calls for consideration of the following:

(a) The relative importance to be given in the establishment of the standards.
(b) Analysis of each function for which a standard is to be established, to determine all factors involved.
(c) Synthesis of necessary factors and the creation of attainable standards for each function.
(d) Reducing accepted standards to written record or a code of practice and procedure.
(e) Means for currently measuring and comparing actual results with the standard for each function.

In order to insure accomplishment of the objective defined in the master program and to secure attainment of standards set up, an incentive must be offered as a reward for securing more than average results. Such incentive rewards may be either financial or non-

PROFIT-MAKING PRINCIPLES IN FURNITURE MANUFACTURING

The Principles	Industrial Definition	Practical Application	Factory Inter-Relation	Result of Use
1-ORGANIZATION	*A Plan and a Means for Carrying out the Objects and Policies of the Business.*	*Delegates Responsibility; Defines Authority; Provides for Administration.*	*Tells Executives who they are Responsible to; who are Responsible to them; what they are Responsible for.*	*Avoids Conflict of Authority Guards against Misunderstandings Insures Realization of Objectives.*
2-OBJECTIVES	*Ideals to be attained or Results to be secured by Policies adopted.*	*Establishes Master Program; Defines Sales, Output & Expense; Visualizes the Tasks.*	*Sets a Production Purpose for Departments and Plant; Limits Expense in Right Relation to Output.*	*Knowing just what is to be done; Knowing Limits to go in Efforts to secure Desired Aims*
3-CONTROL	*Elements which, extending over a Period of Time, co-ordinate Various Factors with the Objective.*	*Gathers Present Data; Balances Data against Objectives; Formulates Plans for Future.*	*Co-ordinates the Functions of Sales, Purchasing and Production.*	*Means for Applying Corrective Measures in Time to Insure Profitable Operation.*
4-STANDARDS	*An Element established as a Result of Analysis; a Fixed Quantity or Measure.*	*Analyzes each Factor Eliminates unnecessary Elements; Sets up necessary Elements for Use.*	*For Plant-in Output & Expense; For Departments-in what they should do; For Individuals-in Daily Tasks.*	*A Task for each Employee that is concrete, definite and understood.*
5-REWARDS	*An Incentive held forth as a Spur for Accomplishment and Proportional to Results Secured.*	*Makes Interest in Standards Real; Provides the Spur for Action; Rewards for Results Secured.*	*Makes all Employees work together to a common End-The Desire for Maximun Results.*	*The Mainspring in getting Profitable Results from every Worker in the Organization.*

FIG. 1 MANAGEMENT PRINCIPLES AND THEIR INTER-RELATION

financial, depending upon the character of service they are to reward and the position in the industrial structure of the individual to whom they are to apply.

Financial rewards, such as piece-work and bonus plans, will properly apply to the individuals whose chief concern is the weekly or semi-monthly pay; com-

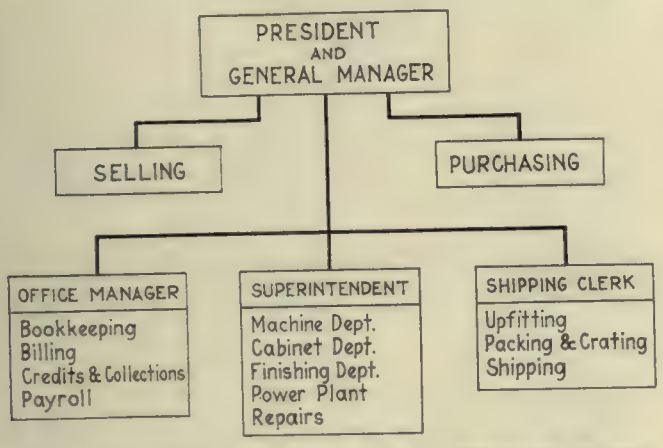

FIG. 2 THE USUAL ORGANIZATION OF A FURNITURE PLANT

missions and department bonus plans, to salesmen and department heads who are paid on a monthly basis; while profit-sharing, percentage of net results produced and non-financial incentives apply with greatest benefit to the executives charged with the conduct of the business.

To mix these plans and their application is to kill their incentive value as a reward offered, and to cause failure in their producing profitable results in operation.

Applying this principle of rewards to industry calls for the following considerations:

(a) The incentive must be sufficient to bring about the attainment of the standard set.
(b) There must be a measured reward proportionate to a measurable result as compared to the standard.
(c) The period between earning the reward and its receipt by the one rewarded should be as short as possible.
(d) The basis on which standards are set and rewards are earned must be fully understood by those to whom they are to apply.
(e) The reward must be devised to apply to individuals, groups, department heads, and the general management.

Inter-Relation of Principles

These five management principles are very closely inter-related in their application to furniture manufacturing. First, the organization must be designed along right lines or no effort on the part of the sales or operating end of the business can compensate for its defects. Second, there must be objectives as to the volume of sales, quality of product, output of the plant, and amount of profit, in order to vision the end which it is desired to attain.

Third, there must be an executive control of results and of the means for securing these results, or the efforts of the personnel will be fruitless. There must be a sense of values, coupled with means for realizing these values in every function in the business. Fourth, the "yardstick" of standards must be applied, so that there will be something against which current performance can be measured and which will make possible action to turn possible losses into positive profits. Fifth and finally, the greatest inducement and incentive for the accomplishment of a task, in the form of a reward over and above the regular wage or salary, must be paid to the manager, superintendent, and department heads as well as to the machine operators and bench hands in the factory departments.

In Fig. 1 is shown a chart of these five management principles and their inter-relation as applied to the manufacture of furniture. This chart, carefully studied, will make clear the various problems which are presented and the solutions of them as shown in the articles to follow.

The general type of organization in furniture manufacturing is what is known as the "military type." In this type the manager puts things up to the superintendent, the superintendent puts them up to the foremen, the foremen put them up to the workers. The work is done by, and the efficiency of execution is dependent upon, the man of least possible breadth of

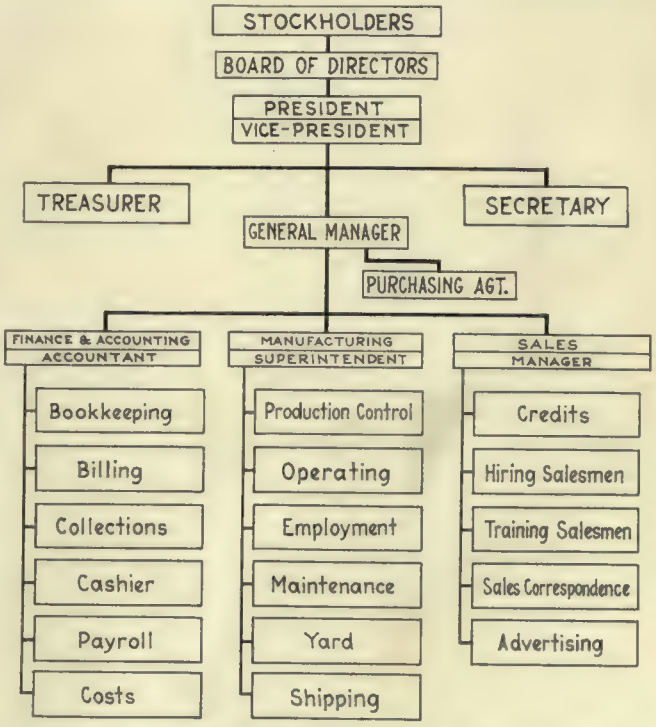

FIG. 3 AN EFFECTIVE ORGANIZATION FOR FURNITURE MANUFACTURING

vision, of lowest capacity, of least knowledge, and of least power to control conditions—the workman at the bench or machine. His only source of help and instruction is but one step higher in knowledge or power, the gang boss or foreman. Such an organization is shown graphically in Fig. 2.

Modern methods of manufacturing demand the same

specialization in administration functions as has been so successfully employed through division of labor in production processes. By dividing the administration of a business into its natural functions, then placing in charge of each function an executive who is specially qualified, the highest efficiency is obtained.

Fig. 3 shows the organization of a furniture manufacturing enterprise employing from 150 to 175 workers, as it appears when operating under a modified functional type of organization. This type of organization has been proved most profitable and successful in actual operation.

There are several general rules which apply to organization plans, the understanding of which will clear up doubt and uncertainty as to what should be done and how it should be done in specific cases:

1. Every executive should know:
   - (a) To whom he is responsible.
   - (b) What he is responsible for.
   - (c) What is expected of him.
   - (d) The responsibilities of other executives whose work involves contact with him.
2. Instructions and orders must:
   - (a) Follow lines of authority from superior to subordinate.
   - (b) Be transmitted through those responsible for results.
3. In operating a function:
   - (a) The man must be fitted to the job—not the job to the man.
   - (b) Functions must not be contracted or expanded to suit a personality.

Some executives may object that the plan of organization shown in Fig. 3 is too complicated and elaborate for their business. The fact is, this plan of organization introduces no new functions into the business. It merely segregates and classifies those that already exist and shows their relation to each other.

When there is not sufficient work to keep a man busy in one function, he then occupies two or more positions, but he knows exactly what relation each position bears to other positions in the organization and to the organization as a whole. And it is very seldom found necessary to add to the existing personnel on account of this organization plan, because the personnel will be found within the organization.

Putting the Organization to Work

To co-ordinate and synchronize the working of the entire organization, and to convey to each executive his responsibilities and duties, the use of written standard instructions has been found to be the most practical means. These instructions comprise a copy of the organization chart, the written definitions of responsibility for each function shown, and standard practice instructions that cover the more important divisions of routine operations. Such instructions facilitate administration in that they:

1. Speedily break in new help.
2. Avoid misunderstanding and neglect of duty.
3. Allocate responsibility.
4. Avoid repetition and the miscarriage of verbal orders.
5. Keep out high-salaried men not essential to the success of the organization.
6. Minimize friction among executives.
7. Develop the organization according to definite plan, avoiding personalities and expedients.
8. Permit changing routine methods to meet changed conditions.
9. Develop men and prove their efficiency.
10. Make possible a quick contracting or expanding of the business.

Written standard instructions, covering the duties and responsibilities of the factory manager, are shown in Fig. 4. Revision of such instructions will be found necessary from time to time, and it is found best to retain the same instruction number, but follow it by a letter that will show that a revision has been made.

This completes the outline of the principles of management, development of the organization that is to use them, and the manner in which details of organization responsibility are taught the operating personnel.

(To be continued in the July issue.)

FORSYTH FURNITURE CO.
Charlotte, N. C.

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STANDARD PRACTICE INSTRUCTIONS

SUBJECT: RESPONSIBILITIES OF FACTORY MANAGER

FACTORY MANAGER
Responsible to the General Manager for

1. Direction, supervision and co-ordination of all departments of the Manufacturing Division of the business, as shown on Organization chart.
2. The determination and administration of all policies governing the Manufacturing Division.
3. The proper and economical execution of all manufacturing programs and shipping orders.
4. The proper care, and maintenance of, and accounting for, all of the Company's property which is assigned to the Manufacturing Division.
5. Issuing purchase requisitions on Purchasing Department for all materials, supplies, machinery, equipment, etc., required for the execution of manufacturing programs and shipping orders, and for upkeep of the property assigned to the Manufacturing Division.
6. Planning the methods of manufacture, the introduction of all special tools, machines, and methods which will improve the quality of the product or reduce the cost of production in a profitable way.
7. Issuing all Production Orders to cover work in the manufacturing departments, on all Manufacturing Programs and Shipping Orders.
8. Planning and scheduling of work on Production Orders; the care and upkeep of the storeroom; the upkeep of stores records; also for records showing progress of the work on all Production Orders and readjusting schedules to conform to actual progress.
9. Issuing of all Plant Orders covering necessary alterations to maintenance of all property which is assigned to the Manufacturing Division.
10. All matters relating to Finished Stock and Traffic, including receiving, shipping, supervision and upkeep of trucks and teams, also for all clerical work connected with the records and follow-up of this work.
11. The employment of all help and the determination of the wage schedules governing them.
12. Installing and maintaining all safety devicies and for supervising medical attention and inspection of plant for all divisions of the company.
13. Operation of the power plant, elevators, motors, and of all transmission machinery throughout the plant, and for their repair and upkeep, also for the supervision of all millrighting, machine repairs, and electrical work.
14. All repairs to buildings and their equipment, also for furnishing proper light, heat, water, ventilation, sewerage, and fire protection for the buildings.
15. The inspection of all incoming materials, work in process of manufacture, and the finished product.

Wm. R. Jones
General Manager

FIG. 4 RESPONSIBILITIES OF THE FACTORY MANAGER

Effective Repair Part Schedules

A Simple Follow-Up System for Short-Time Operations and Orders

By JOHN H. AMES

Production Engineer, Whitin Machine Works

ONE of the most troublesome details that confronts the average manufacturer is the prompt shipment and delivery of repair parts. Almost invariably a customer desires immediate delivery, since some extremely important piece of his equipment (and consequently some division of his business) is probably tied up until the repair parts ordered have been received and installed.

It is desirable for any manufacturer to determine the repair demand for various parts required by his customers. These parts can then be processed in lots of economical quantities, and a properly sized stock can be maintained, ready for immediate shipment. Every factory executive knows, however, that it is not possible to anticipate fully all orders for individual parts; and therefore some arrangement must be made to insure prompt shipment of repair parts which must necessarily be processed in small lots.

Many manufacturers approve the plan of maintaining a so-called "service" department, wherein repair parts only are made, so that the complete attention of such a department can be given to the repair requirements of their customers. While this arrangement possesses several advantages, its adoption is not always possible by reason of the physical limitations existing in many instances. Furthermore, there are many factors in favor of processing all parts in the regular routine manner in the manufacturing departments.

As a general rule, it will be found that short-time operations required on repair orders furnish excellent "fill-in" jobs in the regular machining departments. In addition to this, the processing of parts in small lots in the same departments where the particular machining operations involved are regularly performed, insures the use of the proper jigs, fixtures, and gages, thereby removing the possible hazard of incorrect finishing, lack of interchangeability or incomplete inspection. Some consistent system of follow-up must be employed, however, if repair parts are to be made in the regular manufacturing departments, in order to insure the proper amount of attention which the urgency of such orders requires. A simple system which proved very effective when installed for this purpose in a large machine tool shop is described herein.

ROUTE SHEET Order No. 6192

Name	Price Number
14" H. L. Apron	25-A-224

Date Started	Material	No. of Sheets / Sheet No.	No. of Pcs.	Lot No.

Op. No.	Operation	Dept	Mach.	Tool List	S.U.T.	S.T.	INSPECTOR'S REPORT O. K.	Spoil	Date	Sign
1	Rgh. & Fin. Plane	24								
2	Rgh. & Fin. Mill Pads & Bosses	22								
3	Rgh. & Fin. Mill for Rack Pinion Gear	22								
4	Scrape Apron Seat to Plate	78								
5	Drill & Tap for Carriage	26								
6	Drill & Tap for Pinion, Handwheel & Clutch	26								
7	File Burrs & Round Corners	88								
8	File, Rub & Shellac	14								
	Move to Stock # 85									

FIG. 1 ROUTE SHEET WHICH ACCOMPANIES EACH ORDER THROUGH THE SHOP

As soon as an order for repair parts was received by the sales department, a post-card notice was sent to the customer, acknowledging the order and saying that notice of the delivery date would follow as soon as proper analysis of the order had been completed.

The sales order was entered and issued to the factory by the sales department, and blue-prints, specifications, etc., forwarded by the engineering department, in regular manner, to the production department. A route sheet, shown in Fig. 1, was prepared for each part ordered and attached to the identification ticket of the particular part to which it applied. These route sheets traveled with the parts through the various departments as manufacture proceeded, and for parts made on repair orders, special identification tickets of bright red were used.

When all the route sheets were prepared, they were handed to the schedule clerk, who prepared a 3 by 5 in. follow-up card for each part ordered. The order was then entered in the schedule book, indicating by departments the dates when each should complete its operations, as shown in Fig. 2. In scheduling operations, the schedule clerk did not attempt to assign each job to certain machines, but assumed that each operation could be performed and the part moved to the next department within two days' time. In case two consecutive operations were done in the same department, it was assumed that both could be done in the same day. The schedule clerk was naturally required to exercise some judgment when arbitrarily preparing a schedule of this kind.

Having entered the order in the schedule book, the schedule clerk filed the small follow-up cards at his desk and the route sheets were then forwarded to the shop for starting the actual work. At this time the schedule clerk also entered the scheduled date of delivery of the order on a report of scheduled deliveries, shown in Fig. 3, which was sent to the sales department daily.

On receipt of the daily summary of scheduled deliveries, the sales department reported to the customer the anticipated date of delivery. This procedure gave the customer an accurate idea of the time at which his order would be shipped, since the order had been completely analyzed and the schedule plainly indicated the amount of work to be done by the shop in filling the order. Although the customer was forced to wait approximately two days after his order had been acknowledged before receiving notice of the intended date of shipment, experience proved that this delay was not objectionable. An accurate delivery date, given in good faith on the basis of the amount of work involved and faithfully lived up to (unless accidents prevented), actually resulted in a greater increase of good-will on the part of the customer than could possibly be obtained from a hastily given guess specifying an absurdly early delivery which the shop could not meet.

Having reported the scheduled delivery date to the customer, every effort was made by the factory to make shipment on or before that date. As various operations were completed in the shop and the signed inspection tickets were received by the schedule clerk to indicate their completion, the schedule book was marked accordingly with circles (see Fig. 2), so that the progress of each part ordered could be easily observed.

Each morning, as soon as all operations completed on the previous day had been recorded, the schedule clerk examined the book to determine the overdue operations which had not been completed according to schedule. For each such overdue operation on any repair part, the schedule clerk removed the 3 by 5 in. follow-up card for the part from his desk file and noted thereon the department number in which the operation had not been performed on time. These overdue cards were then handed to a chaser, who investigated these cases daily and made an effort to bring all such jobs up to schedule.

The advantage of this scheme of follow-up can readily be seen, in that the chaser was not wasting his efforts in pushing jobs which were going through without delay, nor was he aimlessly devoting special attention to certain jobs selected at random from the large number of open orders continually in hand. Further than this, the more overdue jobs which could be brought up to schedule by him naturally reduced the number of items requiring chasing, and this condition gave him an added interest in keeping all repair orders up to the minute. When, however, conditions occasionally arose that made it impossible to follow the schedule for an order as originally prepared, the chaser reported the case to the schedule clerk, and a revised schedule was made. The revised date of delivery was then reported to the sales department with the reasons for the change, and the customer was promptly notified.

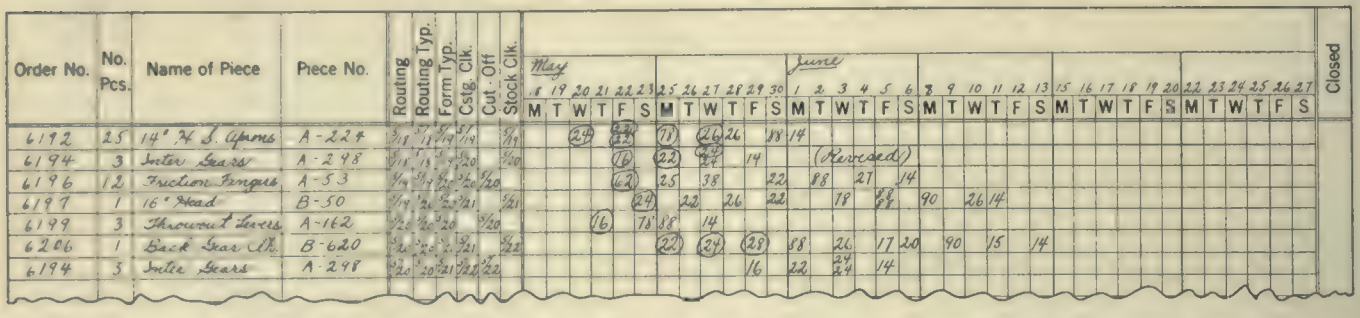

FIG. 2 SCHEDULE SHEET TO SHOW WHEN OPERATIONS SHOULD BE COMPLETED. CIRCLES INDICATE COMPLETED OPERATIONS

SCHEDULED DELIVERY DATES

DATE....May 20, 1924....

SMALL PART ORDERS

ORDER NO.	DATE COMPLETED	REMARKS
6192	June 1, 1924	Omitted from report of May 18th
6194	June 5, 1924	Revised—Defective castings
6199	May 27, 1924	
6206	June 13, 1924	
Etc.	Etc.	

FIG. 3 DAILY REPORT OF DELIVERY DATES SENT TO SALES DEPARTMENT

The effectiveness of the system outlined was vividly shown by the marked decrease in the number of open repair orders two or three months after this scheme had been placed in use, in spite of the fact that business was continually on the up-grade.

Summarizing, the effectiveness obtained resulted from: (1) A speedy but complete analysis of each repair order; (2) an arbitrary schedule based on the actual work required; (3) a truthful report to the customer of the scheduled date of delivery; (4) a well-directed effort to push only those jobs which were behind schedule; and (5) a sincere attempt to live up to the scheduled dates of delivery reported to customers, with an honest report of the actual facts of the case when conditions compelled a revision of the initial delivery date.

Practical Results of Budgeting

Benefits of Industrial Budgets Secured Without Additional Expense

By RALPH H. ALLEN

Assistant Treasurer, Thomas A. Edison, Inc.

THE man who says he does not believe in business budgeting or forecasting is stating a paradox. Consciously or unconsciously every man does believe in and does use budgeting or forecasting in his private life and in his business as well. The form used may vary as well as the extent of the use, but planning ahead or looking ahead—another name for forecasting—is an action inseparable from civilized life. The aim of all science is to reduce phenomena to a state of predictability. Civilization progresses only so far as it is able to anticipate the future. Business succeeds only when its action today is balanced with tomorrow's demands.

The contributions to business literature on the subject of budgeting indicate a wide-spread interest in the subject. Edison, it is said, has contributed, through his many inventions, more to the surplus wealth of this country than any other individual. He is also a manufacturer and a financier, though less known in the latter role. This article gives an insight into an important phase of financing in the Thomas A. Edison industries—business forecasting.

By "business forecasting" is meant the practice of anticipating the future with a view to avoiding or mitigating business catastrophes, providing for periods of want and depression, and taking all possible advantage of approaching changes.

The term "budget" is more limited in its meaning, and generally refers to a component part of a general forecast, a supporting schedule or statement, as "cash budget," "sales budget," etc.

"Business forecast," as used in this article, refers to a prophecy of the business for the next period and represents an aggregation and co-ordination of all the individual cash, sales, manufacturing or other budgets.

In an article "Business Forecasting in the Edison Industries"[1] a statement was made as to the importance of forecasting, the essential being as follows:

Ability to forecast accurately is the barometer of civilization, and ability to forecast accurately in business is the barometer of good industrial management. Hence it can be stated as a cardinal principle that we can determine whether or not a business is being well managed by discovering how accurately it anticipates business conditions. Obviously, if we wrongly estimate tomorrow's business demands we will either overstock our shelves with unsalable goods, or forfeit profits which might have been made on unfilled orders, either error resulting possibly in financial ruin.

Today's business is in anticipation of tomorrow's requirements. When we say that, other things being equal, the business which sees farthest ahead wins, we are simply saying in other words that we stand a much better chance of getting to a place if we know where we are going. In fact, it is this central idea which is behind every sales quota, departmental appropriation, and personal budget.

Business men who never before thought of forecasting their business are beginning to sense its benefits now that the federal government departments are lined up under a systematic national budget. The budget in this case is the first step toward really reorganizing an unwieldy, archaic and expensive system of federal bureau administration. Many private corporations and firms whose methods are also archaic, unwieldy and expensive, can profit by the example.

Budgets Are Built on Past Experience

This is all very well, someone says; we would all like to know about the future; show us the formula that we may become millionaires overnight. There is no specific formula. Time, patience, experience, reliable and complete statistics, and the development of business acumen through hard knocks, are all required to produce an intelligent and reliable forecast in any business.

Anyone who has seriously considered the methods and purposes of forecasting realizes that foresight is 90 per cent hindsight. No magic combination of figures, formulas, or tables will forecast a man's business for him. No more could a stranger, unfamiliar with a

[1] This was the first of a series of seven articles written by Edison officials, in collaboration with Ralph H. Allen, describing the budget methods employed in the group of 17 active corporations comprising the Thomas A. Edison Industries. They appeared in *"Administration,"* October 1922 to April 1923, inclusive. This series attracted so much attention that, although we had published more than 3000 copies in excess of our normal subscription requirements, our supply of copies was completely exhausted. To take care of those who were unable to obtain copies certain of the numbers were reprinted in pamphlet form.—EDITOR.

certain business, properly draw up a forecast for it on demand. Success depends, in the first place, upon the existence of reasonably complete and reliable data, and given this, is in proportion to the effort made to analyze and use these records of the past.

TABLE 1. CONDENSED BUDGET,
EDISON STORAGE BATTERY COMPANY
Year ending February 28, 1926

	Dollars	Per Cell	% to Sales
Sales:			
Cells	xx	xx	xx
Supplies, repairs, etc.	xx	xx	xx
Total	xx	xx	xx
Less .. % required percentage of profits to be set aside for the management	xx	xx	xx
Net	xx	xx	xx
Cost to make: (Detail)	xx	xx	xx
Net	xx	xx	xx
Cost to sell: (Detail)	xx	xx	xx
Net	xx	xx	xx
Miscellaneous expenses: (Detail)	xx	xx	xx
Net profit after deducting .. %	$ xx	xx	xx

Business forecasting, like any other art or science in its infancy, is now wavering between theory and practice. Some corporations become so enthusiastic over its possibilities that separate departments are organized to take care of it. Forms without number may be prepared, many men may be employed to prepare and keep them. Expense may increase. Thus may a theoretical application of a practical idea ruin the object.

A proper budget or forecast should save money, reduce overhead, and improve executive control.

When setting up the system of budgetary control in the Thomas A. Edison Industries, Charles Edison, Chairman of the Board of Directors, stated:

> It is understood that this system is not to cost money, but to save it. Pay-roll and expenses are not to be increased. In fact, I shall be disappointed if, at the end of the first year, you shall be unable to show me that it has not saved the corporations many thousands of dollars.

The test of any forecast—the test that sends many forecasts into the discard—is the test of comparison with the final figures.

The forecast of total sales in the Thomas A. Edison Industries for the year ending February 28, 1925, a forecast which was made 12 months in advance, was 91 per cent correct.

The monthly estimates of surplus made 30 days in advance were on an average 98 per cent correct.

A variance of more than 5 per cent in any of the *monthly* estimates of sales, expenses or profits is considered a reflection on the estimator.

Technique of Business Forecasting

The function of budgeting or forecasting is fundamentally allied with the other functions of good management. Therefore, it is logical to expect that it may be carried on as an integral part of the functions of management. It is unnecessary to build up a super-organization to handle it.

Those managers who are responsible for carrying out the policies of the management, as to financing, selling, and manufacturing, are the ones best fitted to make up the individual budgets; and they are the ones who profit most thereby.

The origin of the budget, or its source, is among the departments themselves. The first figures or estimates emanate from the men who are on the firing line, in the factory, or in the office.

Whence do the figures go from that point?

The answer to this question is explained in detail in the Manual of Instructions covering Budget Control in the Edison Industries, which is reproduced below:

I. Q. *What are the advantages of having a Budget? Why should we have one at all?*

A. The main object of a budget is to secure better control.

Some of the advantages are:

1. At all times the budget serves as a measuring stick to compare actual performance with promises and standards, showing not only what may be done, but what should be done.
2. Every manager in the organization has a definite goal to attain.
3. Sales and production plans are co-ordinated with financial resources.
4. It provides a basis for working out in advance a policy as to:
   (a) Investments
   (b) Expansions
   (c) Bank loans
   (d) Purchases
   (e) Selling prices
   (f) Production
5. Costs may be used for purposes of control by comparison with standard budgets rather than as historical information.
6. Indirectly it should be an aid to good management in the reduction of waste, better balanced inventories, definite assignment of responsibility for expenditures, more continuous operation, greater regularity of employment, and standardization of processes and equipment.
7. Taken in conjunction with the "business cycle," the budget gives warning to be cautious and the cue to go forward.
8. The United States government thought well enough of it to put in a budget system. The largest corporations in this country have followed its example.
9. If superintended with common sense, the budget should result in economy.

II. Q. *What will be the expense of following the budget program herein submitted?*

A. The expense will be nil, the work being carried on without additional help.

The preparation of the budgets under the direction of the departmental heads will not require a lot of detail.

The co-ordination of the various budgets into a master budget will be done in the office of the assistant to the chairman of the board.

III. Q. *How far will the managers go in budgeting their business?*

A. The benefits of budgeting will be extended to all production departments and selling branches wherever practicable.

Wherever this is done, a copy of the production, or the sales budget, will be attached to the budget submitted by the manager.

IV. Q. *What is the basis of the managers' budgets?*

A. Several conditions should be taken into consideration, but the principal ones are:

1. Past performances
2. Consideration of any changes in Edison policy.
3. National business conditions
4. Manufacturing limitations
5. Selling limitations

V. Q. *What are the budgets to cover?*

A. Sales, expenses and profits for the year, in a form similar to Table 1.

VI. Q. *How are the budgets to be handled?*

A. 1. They are to be prepared by the manager.
2. They are to be sent to the chairman of the board.
3. They are to be checked by the assistant to the chairman of the board.
4. Approved by the chairman of the board.
5. Approved copy to be returned to the manager.
6. Consolidation into a master budget by the assistant to the chairman of the board.
7. Copies of master budget to be distributed as follows:
   (a) Original to chairman of the board.
   (b) Carbon copy to president
   (c) Carbon copy to assistant to chairman of the board.
   (d) Carbon copy to treasurer.
   (e) Carbon copy to secretary.
   (f) Carbon copy to auditor.

VII. Q. *What use is to be made of the budget during the year?*

A. Comparison of the budget with actual figures, to be made from time to time throughout the year by the assistant to the chairman of the board, and result thereof with explanation of differences submitted to chairman of the board and/or the president. *The budget is to be used as a basis of manufacturing (production), selling and financing throughout the year.*

VIII. Q. *Are budgets to be revised during the year?*

A. Yes, whenever any extraordinary change in the trend of business so warrants, a revised budget will be requested (of any manager) by the chairman of the board or the assistant to the chairman of the board.

IX. Q. *What percentage of accuracy should be attained?*

A. If 95 per cent of accuracy can be maintained it means that the business may be run, generally speaking, with reasonable safety on the budget figures without waiting for the actual figures to come through.

X. Q. *What is the organization for budgetary control?*

A. Chairman of the board will have direct control of all matters pertaining to the budgetary program; to consider all departmental estimates, make changes and revisions; periodically receives through his assistant reports showing a comparison of the performance for the period with the estimated performance. No estimate is effective until it has the approval of the chairman of the board.

XI. Q. *What are the duties of the assistant to the chairman of the board?*

A. Will act as his personal representative in all matters pertaining to the budgetary program.

General duties:

1. To receive from the managers the periodic estimates, or budgets, in form and manner directed by him.
2. To prepare from the budgets an estimated balance sheet, and an estimated statement of profit and loss.
3. To receive the estimates as approved, and transmit them to the managers.
4. To furnish the chairman of the board, and/or the president, with periodic reports showing a comparison between the estimated performance

TABLE 2. BALANCE-SHEET-PROFIT-AND-LOSS STATEMENT

The following figures are not in any sense indicative of the business of Thomas A. Edison, Inc., or any of its constituent companies, but are purely for the purposes of this article.

(Dollars in thousands)

	Cash	Receivables	Inventories	Deferred Charges	Notes Payable Banks	Other Payables	Accruals	Investments	Working Capital	Plant	Plant Reserves	Bonds	Capital	Surplus
Sales		1,000	*700*						300					*300*
Collections	950	*850*			*100*									
Disbursements:														
Pay-rolls	*200*						200							
Other	*1,008*			8	200	650	10		*140*			100		40
Purchases			480			*555*			*75*	Eq. 5				70
Journal transfers:														
Income from investments				1					1					*1*
Pay-rolls			152				*217*		*65*					65
Plant reserves			10						10		Bldg. *2* Eq. *8*			
Income taxes							*8*		*8*					8
				Ins. *2*			Com. *50*		*50*					50
Miscellaneous				Int. *5*			Roy. *4*		*11*					11
Totals	*258*	150	*58*	2	100	95	*69*		*38*	5 L 50	*10*	100		57
Beginning balance	503	1,147	2,946	27	*1,000*	*725*	Acc. *12* Tax *100*	200	2,986	B 420 E 765	B *105* E *218*	*500*	*2,500*	898
Ending balance	245	1,297	2,888	29	*900*	*630*	Acc. *73* Tax *108*	200	2,948	L 50 B 420 E 770	B *107* E *226*	*400*	*2,500*	955

and the actual performance for the period for each division.

Unless some systematic plan is followed, when all the budgets, appropriations, schedules, estimates, and forecasts are brought together, the industrial manager may well pause in bewilderment and wonder whether there is not some quick, efficient way to co-ordinate and clearly present this information, so as to show each element in its true relation to the other and to the whole. The Edison Industries have found the best method of doing this—the most effective means of co-ordinating its forecasts—to be the balance-sheet-profit-and-loss statement.

Business men are beginning to realize more and more the importance of the balance sheet as the mirror of their business, whether they are interested in credit negotiations, bank loans, mergers, reorganizations, or current conditions.

The balance sheet speaks a universal language understandable to all financial men, accountants, credit men, and business managers in general. A forecast constructed in its terms needs but little explanation. It is ideal as a forecasting medium, whether divisional or departmental balance sheets are used, or the grand total consolidated balance sheet for the business as a whole. If at the same time the profit and loss items can be indicated, both the causes and effects of the business results may be seen at a glance.

The balance-sheet-profit-and-loss statement, the form of which as used in the Edison Industries is shown in Table 2, is dependent for its component parts upon the reports, budgets, and estimates of a number of subordinate officials. In practice conditions reflected on this statement have in many cases called for immediate attention, so that correction could be made before damage was done. Through the use of this form it is possible to furnish estimated balance sheets to stockholders, directors, officers, or banks, either before or within a few days after the date of closing the books. When the actual figures arrive, perhaps a month or more later, any variation may be analyzed readily.

TABLE 3. TREASURER'S DEPARTMENT—CASH ESTIMATE
Month of May, 1925
(Dollars in thousands)

Balance beginning		503
Receivables collected	850	
Income from investments		
Bills payable, discounted Blank Bank due	100	950
		1,453
Disbursements:		
Bills payable, repaid X Bank	100	
Bills payable, repaid Y Bank	100	
Pay-rolls, 4 at 50	200	
Accruals, commissions paid	10	
Deferred charges:		
Insurance premiums	6	
Interest on bank loans	2	
Payables paid	650	
Expenses	40	
Bonds redeemed	100	1,208
Balance end		245

Every time this analysis is properly made it results in greater accuracy in the next forecast.

To simplify the compilation of the balance-sheet-profit-and-loss statement in actual use, all debits are black and all credits are red. In the form shown in Table 2 debits are in roman while credits are italicized.

Possibly that portion of a company's assets giving most concern to the management is its cash. A proper bank balance must be maintained if the company is a borrower, and since the world's painful experience in deflation after the World War, business men more and more recognize the fact that the profits realized in cash are the only profits which, not being subject to revaluation downwards, may be called real.

Most concerns budget their cash income and outgo periodically, some using elaborate methods covering weeks and months ahead and some looking forward only a few days. As all profits must finally be realized in cash and all obligations settled in cash, it naturally follows that the efficient treasurer must keep in close touch with all the departments of the business, their problems, and needs. Being a member of the board of directors he has knowledge of any proposed heavy expenditures and is thereby enabled to pass on their advisability from the viewpoint of their ultimate payment.

TABLE 4. PURCHASING DEPARTMENT ESTIMATE OF PURCHASES
Month of May, 1925
(Dollars in thousands)

Raw material, factory supplies, etc		480
Equipment		5
Expense:		
Advertising	50	
Other	20	70
Total		555

For his own guidance, and that of the board of directors, the treasurer forecasts his income and expenditures as shown in Table 3. As in the case of all the estimates used in making up the balance-sheet-profit-and-loss statement, this estimate is submitted on the first of the month to which it applies.

The Purchase Budget

The purchasing agent, in close touch with the factory, can estimate its needs for the coming month with fair accuracy. To do this efficiently will necessitate conferences with the factory manager, sales manager, chief storeskeeper, production man, and others. The value of such conferences is obvious.

In addition to the factory requirements, other obligations to be assumed during the month must be scheduled. The advertising charges, as a rule, may be accurately forecasted, as may other expenditures for service, etc.

When the purchasing agent prepares his budget, it should be checked with the treasurer to ascertain if the expenditure dovetails into the financial program, and is in accord with that adopted by the directors.

The purchasing budget should be prepared in detail and show purchases by kind and value, segregated so that it may readily be used for forecasting purposes. The form shown in Table 4 gives without details the analysis for the proper preparation of the forecast.

(To be continued in the July issue.)

Shop Ventilation as an Investment

Ways in Which Equipment Pays Dividends on Its Costs

By A. G. ANDERSON

Research Engineer in Industrial Management, University of Illinois

GOOD air is a necessity in all industrial plants not only for the benefit of workers, but also to meet the exacting demands of present-day production.[1] It is no longer just a "welfare" consideration, but bears directly on effective plant management.

The adverse effects of bad air are serious. High temperatures, particularly when combined with high relative humidities, affect the mucous membranes of the nose and predispose individuals exposed to them to illness and bacterial infection. Subsequent exposure to cold, as when leaving a plant during the winter, is harmful. Dry air produces an irritation of the membranes of the respiratory tract, causes nervousness, colds, influenza, grippe, etc.

Air should be free from dust,[2] smoke, fumes, odors and disease-carrying germs, originating outside or inside the plant. Exhaust fans, air ducts and hoods are usually provided to remove air made bad from these causes within the work place without giving it an opportunity to diffuse and contaminate the general supply. Proper air conditioning will oftentimes prevent dust from forming, and dust movement in the air can be checked.

Courtesy of the Carrier Engineering Company

FIG. 1 VIEW IN THE WHITMAN CHOCOLATE COMPANY PLANT
Conditioned air is essential in making fine candies.

Loss of oxygen and increase in carbon dioxide content in the air when breathed were formerly considered serious matters, but later investigations have shown that the effects from these conditions are negligible. The organic poisons presumed to be exhaled in the breath, or thrown off by the body, are little understood by physiologists, although they may be very important.[3] The New York Commission on Ventilation noted a distinct effect of vitiated air upon the amount of physical work accomplished. "Temperature and humidity being the same, our subjects performed 9 per cent less work in stale than in fresh air, a difference less marked than that produced by warm as compared with cool air (15 per cent) but apparently significant. When both unfavorable conditions were combined, only 77 per cent as much physical work was performed as in cool fresh air."[4]

Body odors, and those arising from an increased carbon dioxide content and other causes are not harmful except as they may affect the appetite They may be removed by the use of ozone from outside air taken in, or from air to be recirculated. Variability is an essential characteristic of an invigorating atmosphere as well as air circulation. Too great a contrast between prevailing atmospheric conditions in summer,[5] and ideal standards for ventilation warrants a compromise, so that the body will not suffer a shock from the change. Motion of the air sufficient to break up the blanket of stagnant air which sur-

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[1] See MANAGEMENT AND ADMINISTRATION, May 1925, pp. 439-442, "Good Factory Air Pays in Increased Output," by A. G. Anderson.

[2] W. B. Clark, in an address before the Illinois Manufacturers' Association, made the following statements: "A report of carefully collected data proves that death rates have been reduced from 60 to 5 per cent by introducing good ventilating and dust-collecting systems in dusty plants. One prominent plant claims that, since putting in a dust-collecting system, the absence of employees from work has been reduced 85 per cent; they also add that a better day's work was obtained from their employees, and more harmony and satisfaction among their women and men employees prevail."

[3] "The Weather Vein," Carrier Engineering Corporation, April 1921, p. 12.

[4] "Ventilation," New York State Commission on Ventilation, p. 198.

[5] In winter the body is more resistant and protected by clothing.

rounds the body in the clothing is required, as the beneficial influence of conditioned air depends upon its contact with and cooling of the skin.

Air washing and humidifying equipment, making possible the control of the moisture content and cleanliness, as well as the temperature, has been available only during the past 20 years. Weather control is now practiced in over a hundred industries, and the effect of climate on materials is thus eliminated. It often saves time and production space, assures the quality and purity of the product, and permits the establishing and maintenance of standard production schedules.

Courtesy of the Carrier Engineering Corporation

FIG. 2 MIXING ROOM OF THE GORDON-PAGEL BAKERY, DETROIT

Air conditioning assures cleanliness, more loaves per barrel of flour, and scientific control of dough fermentation.

In candy making the air must be clean and pure, thoroughly distributed, cool and relatively dry.[6] The confectioner may then avoid "gray chocolates," stickiness, lack of a glossy finish on hard candies, etc. Quality and appearance are vital to sales success. (See Fig. 1.)

A porcelain sanitary ware maker increased his plant capacity 125 per cent, decreased quantity of stock in process 74 per cent, and reduced the production time of one drying operation from an average of 17 to 21 days, to 18 hr., by air conditioning. Rejects were eliminated by the uniformity and dependability of control. "Manufactured weather dries any material at maximum speed because it is automatically adjusted to meet the exact requirements of the given material at the given instant in its drying progress. . . . The control device is equipped with a timing mechanism which automatically alters the temperature and humidity at fixed intervals of time, from the beginning to the end of the drying process."[7]

In cotton manufacture if the fibers are too dry they are brittle and easily broken. If too wet, they are easily pulled apart, easily stretched beyond their elastic limit and weakened. Control of the temperature and humidity within definite limits is essential to quality and quantity output of cotton, wool and silk goods. Paper, like textiles, involves the treatment of fibers—wood, cotton, flax and many others. These fibers are as delicately sensitive to variations in the surrounding atmosphere as are the fibers used in textile manufacture. This moist paper is weaker in tensile strength than dry paper, and the quality of the printed impression depends upon the effect of the temperature on moisture content of the paper.

Makers of fine wood furniture, likewise, need to maintain uniform and favorable air conditions throughout their plants. Strength of glued joints, workmanship and finish depend upon it.

Air conditioning enables the baker accurately to control the weather in his plant, an absolute essential to standardization and uniformity of product. Bread experts have discovered that the yeast germ works best at a temperature of 80 deg. fahr. and a relative humidity of about 65 per cent. Ordinarily, the fermentation period may take five or six hours—with "manufactured weather," a maximum of three. Further, in unconditioned bakeries, fermentation must frequently be forced, requiring more yeast and flour. When ideal conditions prevail, as many as 15 more loaves of bread are secured from each barrel of flour. Icings, frostings and cake decorations are affected by too much moisture in the air. In the dough room, air which is

Courtesy of Frank D. Chase, Inc.

FIG. 3 WILCOX MANUFACTURING COMPANY, AURORA, ILLINOIS

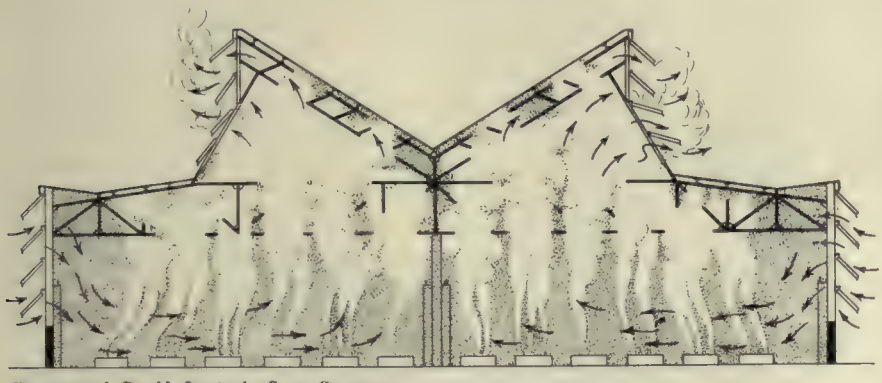
Flat roof monitor gives perfect light and ventilation. "Runs" of sash in monitor and side walls are motor operated en masse. Single sashes in side walls are hand regulated.

[6] The writer is indebted to the Carrier Engineering Corporation for much of this descriptive material.

[7] "The Weather Vein," Carrier Engineering Corporation, March 1923, p. 22.

too dry will absorb moisture from the dough, causing crusting. Unsightly lumps appear, fermentation practically ceases, blow holes form, and the final product is deficient in appearance and taste. When it is known that several bucketfuls of dirt and soot are washed from the air each week in some installations, the cleanliness and purity of the air supplied through conditioning apparatus are appreciated. (See Fig. 2.)

Many food product plants desire that their goods reach the consumer crisp and appetizing, and this object is attained by atmospheric control in the factory in combination with delivery in sealed containers. Drugs, pharmaceutical and biological products, surgical and hospital supplies need to be prepared and packaged in conditioned air for obvious reasons.



Courtesy of David Lupton's Sons Company

FIG. 4 CROSS SECTION OF A TYPICAL POND TRUSS FOUNDRY

Natural currents keep the air clear. Gases and heat will escape against a light wind if the lower outlet lines on the windward side are closed as shown.

The manufacture of airplanes on a quantity basis calls for controlled atmosphere. The materials must be cut and assembled under uniform air conditions if they are to swell and shrink uniformly in the finished planes, which is very important. The manufacture of watches and fine machinery, and the use of delicate equipment necessitates air free from dust and moisture. Automatic machinery is often dependent upon an unvarying state of the materials it handles if it is to function satisfactorily—as in gum making and wrapping. The presence of "static" interferes with many machine operations and is usually indicative of low relative humidities. It may be eliminated by increasing the moisture content. Perspiration on the hands of those packing polished metal objects may cause tarnishing. The remedy is to reduce the moisture content of the air.

The moisture content of paper and the temperature of the room affect printing, hence printing establishments have found that atmospheric conditions affect the quality, quantity and cost of production. During winter months the air must be cleaned, heated and moisture added; while summer air must be cooled and its moisture content reduced to the desired standard. Paper is a hygroscopic material, shrinking or stretching depending upon whether the air is cold or dry, or warm and humid, large sheets varying as much as ½ in. In color printing, as many as 35 runs through the presses may be required, over a period of several weeks, and "register" necessitates accuracy to within 0.02 in.

Window ventilation under favorable climatic and weather conditions may prove adequate in workrooms where the number of employees is limited, where vitiation of the air supply is not a problem and where the effect of the atmosphere on materials is not a factor. Fresh air enters and is tempered by the heat from radiators or by mixing with the air supply in the room. Inattention to window ventilation results in no ventilation. Likewise cold, rain or snow affects the supply of air from such sources and renders them ineffective. Those nearest the windows may be too cold, others too warm. In any event, the humidity, purity and circulation of the air is not subject to control and the temperature only partially. Window ventilation may be improved by providing a means of escape for the used air in the room through ducts. The natural movement may be increased and the circulation in the room improved by placing aspirating coils in the ducts, or by using exhaust fans. In small workshops and for particular work places a cooling effect of the air may be obtained by using a local fan system to blow a current of air upon those employed. High velocity at short range even without a high humidity of the air often proves sufficiently cooling to be worth while.

Exhaust fans placed in outside walls may be used in conjunction with window ventilation to effect air changes. They are effective in removing odors, steam, fumes, gases, heat, etc., from laundries, kitchens, galvanizing rooms and heat-treating departments. Their effectiveness decreases as the room area increases and due to any opposing currents of air which may be set in motion. The local application of the exhaust or vacuum principle is very common and useful. Hoods are placed at the points of origin of dust, smoke, heat, etc., and the objectionable elements are drawn directly into them and removed.

Ventilators placed on the roofs of buildings afford outlets through which heated air may escape. Natural chimney action is greatly increased due to the convection currents set up in the ventilators by wind currents across their tops; thus bad air is pulled out of the building. This equipment is effective in heat and drop forging plants, paper mills, boarding departments of hosiery mills, in textile industries, boiler and engine rooms, etc. Ventilator efficiencies are decreased by absence of wind movement, by cross currents of air in the building, or by an insufficient inflow of fresh air.

In the textile industry humidification is often accomplished by use of unit humidifiers. These are suspended at intervals from the ceiling and give off a very finely divided water spray which the air absorbs, the degree of humidity being controlled by hygrometers. Lack of control of the temperature especially during the summer months may result in great discomfort, as the heat generated by textile machinery is considerable. The humidifiers are more economical than a central installation of air conditioning equipment which will control

both temperature and humidity, and may suffice under favorable climatic conditions.

In order to get rid of high temperatures, smoke, gases, fumes and dust in steel mills, tube mills, foundries, forge shops, core rooms, and machine shops,

Courtesy of David Lupton's Sons Company

FIG. 5 MOLINE MALLEABLE IRON COMPANY FOUNDRY, ST. CHARLES, ILLINOIS

Excellent example of Pond trusses and sidewall sash used for natural ventilation.

designers increased ceiling heights so that the heated, vitiated air might rise above the workers, and evolved various types of pent houses, monitors and roof trusses through which it might escape from the building. (See Fig. 3.) Not all of these designs were successful, due to the lack of adequate air inlets near the floor, cross currents set up, and the lack of a natural draft through the monitor openings when outside temperatures were high in summer. It was not until the invention of the Pond truss that satisfactory ventilation was possible in many of these buildings. (See Figs. 4 and 5.) This truss, named after its inventor, consists of a wide M-shaped roof construction with sides of top-hung windows which may be opened en masse, and yet furnish storm protection. It provides a much larger area of roof opening than the ordinary monitor, and the roof slopes are designed to lead the air naturally to and through the outlets. Masses or "runs" of controlled sash are also built in the side walls of the building to provide air inlets.

When large floor areas are to be ventilated air may be drawn in through A-frames built in the roof. (See Fig. 6.) By means of these openings natural air movements can be induced which serve to remove heat and smoke without diffusing it in the working areas. Unlimited floor areas may be ventilated by a proper disposition and design of Pond trusses, A-frames and side-wall sash, an achievement not possible with sawtooth roof construction. Another great advantage is that the height of the side walls may be greatly reduced, the governing factor now being the clearance needed for crane service and for inverted roof slopes. Due to the natural air currents set up and the large area of roof opening, the air tends to rise and pass out quickly and directly without diffusing. Inlet and outlet areas should be balanced, and the incoming air admitted near the floor level even at some inconvenience if conditions seem to necessitate extra care in planning.

Obviously air conditioning is not accomplished by any of the methods described above to a greater extent than removing the bad air and bringing in fresh outdoor air. In many instances, however, the successful accomplishment of this result provides a tremendous improvement over previously existing conditions, at a small cost, and may be all that is practicable.

In order to obtain clean air the incoming supply may be drawn through an adhesive coated filtering media installed in the entrance to the duct system, and as much as 99 per cent of the atmospheric dust, dirt, soot and bacteria filtered out. Such material will remove soot and smoke more effectively than air washers, and hence is desirable in conjunction with them. It provides probably the cheapest means of securing clean air which is always desirable. However, it does not give control of the moisture content.

Absolute control of atmospheric conditions indoors is practically a necessity in many plants and this may be achieved by the installation of air conditioning apparatus in combination with a duct system for its distribution, and another for its removal, if required. Air is drawn into the apparatus, washed, cleaned and tempered as desired, then forced into the duct system for distribution. When the air enters the condition-

Courtesy of Frank D. Chase, Inc.

FIG. 6 SAGINAW PRODUCTS COMPANY, SAGINAW, MICHIGAN

Excellently lighted and ventilated. All smoke, fumes and heat pass out through the A-frame overhead.

ing machine, the spray water may be automatically maintained at a temperature which will take heat from the air, and thus reduce its moisture content. The result will be to dehumidify the air. The same equipment may be used as a humidifier by raising the temperature of the spray water so that it will convey heat to the air and increase its water content.

The benefits to be derived by manufacturing weather to exactly fit production needs and to maintain healthful conditions for employees should be appreciated by all employers. These installations are not an expense to install and operate but, on the contrary, in most cases pay large dividends on their cost.

Simplifying Cost and Price Figuring

Table and Slide Rule Methods from Glass Industry

By RUDOLPH ROSENTHAL

Assistant Treasurer, Jacques Kahn, Inc.

THE office, or salesmen, in factories using glass for the making of mirrors, table tops, shelves, etc., figure the price with the use of one list, in a quick and accurate manner. But when it comes to rapid figuring of cost and profit in connection with price, the common method is cumbersome. A single table, containing all figures needed, and the slide rule produce much faster and sufficiently accurate results.

To figure prices of mirrors for quotation, a booklet is used, consisting of about 50 pages, listing about 4500 sizes with corresponding prices. These prices are used in connection with a few discounts, such as 88 per cent, 90, 10 and 5 per cent, 90 and 40 per cent, varying according to raw material cost, quality, quantity, market conditions and similar influencing factors.

For figuring cost, though, more basic information is needed. There is the price-list of the glass factory for glass used for mirrors, giving the cost of the unit (square foot) in the different qualities and brackets. Brackets are square foot areas, such as 5 to 7 sq. ft., 10 to 25 sq. ft., in each of which the unit price is different. Certain ranges of sizes, while belonging in area to a given bracket, are listed in higher brackets if one dimension exceeds a certain length, or some frequent sizes are listed in a lower bracket than corresponds to their area.

To figure glass cost of a given size, this unit price has to be multiplied by the square foot of its area. For this purpose we use the square foot book published by the largest plate glass factory in the United States, consisting of 50 pages and about 3000 sizes, each size showing the corresponding square feet in full and fractional inches, such as, for example, 38 by 44 in., equals 11 ft. 7 in. 4 pt. Or we can use their glass factory price-list with square foot figures. Before this handy book was compiled, many used and perhaps still use the "Glass Dealers' Ready Reckoner."[1]

For our production records and for cost accounting purposes, we use the square foot book and a decimal table, giving at a glance the square foot fractions in three decimals. Furthermore, we have tables arranged as to qualities and brackets, recording our own manufacturing cost. They vary little and only gradually so far as our main product is concerned.[2]

To simplify figuring, I have devised the table shown in Fig. 1, which gives all necessary data on an 8 by 11 in. sheet. This table combines raw material price-list, manufacturing cost list, finished product price-list, discount table and square foot book. It allows us to see at a glance to what bracket the size in question belongs, so as to pick out the corresponding unit glass and manufacturing costs, which are ranged as to quality and bracket. The price could not be figured in units (square foot) on account of its variations, but had to be inserted in the table as per list. For slide rule figuring purposes, it is sufficient to use four significant figures. The table also lists the formulas used for slide rule figuring of area (square foot), glass, manufacturing and total cost per size, price less discount and profit. Very large sizes, occurring rarely, were left out of the table. Discounts are given in simple figures. It takes only a few hours to make a new list,

TABLE 1. COMPARISON OF OLD AND IMPROVED METHODS OF FIGURING

EXAMPLE: 1 MIRROR 20×56, C QUALITY, DISCOUNT 90/10/5
FIND NET PRICE, COST, PROFIT AND PERCENTAGE

OLD BOOK AND LISTS METHOD	NEW TABLE AND SLIDE RULE METHOD
1. *Net Price.* As per price-list on page 11 find list price—$133.85. Figure discount 10%..... $13.39 Less 10%..... 1.34 $12.05 Less 5%..... 0.60 Gross Price..... $11.45 Less 8%..... 0.92 Net Price..... $10.53	1. *Net Price.* See table list price, discount and net price formula. $Pn = pl \times dn$ $Pn = \$133.90 \times 0.0787 = \$10.53$ This multiplication can be performed instantly on the slide rule.
2. *Total Cost.* Take the square foot book and look up on page 5 the size 20×56. Find that it corresponds to 7-9-4, that is 7-9/12 and 4/144 sq. ft., and is in bracket W (7-10 sq. ft.). Find that on the glass price-list and manufacturing cost list tables (Fig. 1) the unit (sq. ft.) price in bracket W is equal to 93+3+34=$1.30. Multiply this amount by the sq. ft. of the size 20×56, and get the total cost as result. 7+9/12+4/144 sq. ft. area $1.30 unit cost per sq. ft. 4/144×$1.30=$0.036 9/12 ×$1.30= 0.975 7 ×$1.30= 9.10 $10.11 or substitute for 7-9/12-4/144 the decimal equivalent and figure 7.778 sq. ft.×$1.30=$10.11.	2. *Total Cost.* Locate on table size 20×56 as to bracket. Add mentally in bracket W, quality C on glass and manufacturing cost tables (Fig. 1) 93+3+34=$1.30. See formula: $C = (gl+3+ml)(l \times w \times 0.00694)$, therefore $C = 130 \times 20 \times 56 \times 0.00694 = \$10.11$ This multiplication is performed on the merchants' slide rule with only two settings of the slide. To 130 on D set 20 on CI. Indicator to 56 on C. Left index to indicator. Opposite 694 on CF, find 10.11 on DF.
3. *Profit.* Figure net price and total cost as in (1) and (2), then deduct cost from price: $10.53 − 10.11 $ 0.42	3. *Profit* can be figured direct by using table and formulas and rule: Gain $= pl \times dn - (l \times w \times 0.00694)(gl+ml+3) = (133.9 \times 0.0787) - (20 \times 56 \times 0.00694 \times 1.30) = 10.54 - 10.11 =$ $0.42.
4. *Percentage of Profit.* Figure (1) and (2) to get (3) and find: 0.42÷10.11 =about 4%.	4. *Percentage of Profit.* Use table, formulas and rule: $\text{Per cent} = 100 - \frac{l \times w \times 0.694 \times C}{pl \times dn \text{ (in cents)}}$ $= 100 - \frac{20 \times 56 \times 0.694 \times 130}{13390 \times 0.0787}$ $= 100 - 96 = 4\%$

[1] Published by Pilkington Brothers, Ltd., in St. Helens, Lancashire, in 1884.

[2] See MANAGEMENT AND ADMINISTRATION, May 1925, p. 429, "Picking the Profitable Products."

when prices change, which, on an average, happens not more than twice a year.

Other tables are in preparation for the purpose of quickly estimating cost and profit of other products, such as bevelled or mitred mirrors and plain glass with ground or polished edges.

The following description explains fully the formulas listed on the table:

1. *Size or Area.* This expressed in square feet is the product of the inch width and inch length of the size in question, divided by 144, or multiplied by the reciprocal. $S = l \times w \times 0.00694$.

2. *Glass Cost per Size.* The glass price-list on the table shows prices at factory in units (square feet) in the different qualities and brackets (area). Three cents have to be added per unit for packing and freight. To figure cost per size, this glass list price has to be multiplied by the size (square foot area). $G = S \times$ (glass list price $+3$), or $(l \times w \times 0.00694)(gl+3)$.

3. *Manufacturing Cost per Size.* This cost is also listed on the table per unit (square foot) according to bracket group and quality, and has to be multiplied by size (area). $M = S \times$ manufacturing list cost, or $M = (l \times w \times 0.00694)ml$.

4. *Total Cost per Size.* This is the total of glass list cost and manufacturing list cost per unit multiplied by size. $C = (gl+3+ml)(l \times w \times 0.00694)$.

5. *Price per Size.* The prices are listed in the table per size in four significant figures. This list price has to be multiplied by the gross or net discount figures as shown on the table. The price according to nominal trade discount we call gross price, while the net price is 8 per cent less, this being a deduction for selling expenses, such as commissions, discounts, freight allowances. A discount of 88 per cent of the list means the net price is 12 per cent of the list, which can, of course, also be expressed by multiplying the list price by 0.12. We call this multiplier d. The formulas for gross or net price according to the list price and discount tables are therefore expressed as: $Pg = pl \times dg$; or $Pn = pl \times dn$.

6. *Profit or Gain per Size* is shown in the following formula by deducting cost from net price. Gain $= Pn - C$, or Gain $= pl \times dn - (l \times w \times 0.00694)(gl + ml + 3)$.

7. *Per Cent of Gain per Size* represents the gain divided by 1 per cent of the price. For the gain on the net price, the formula reads:

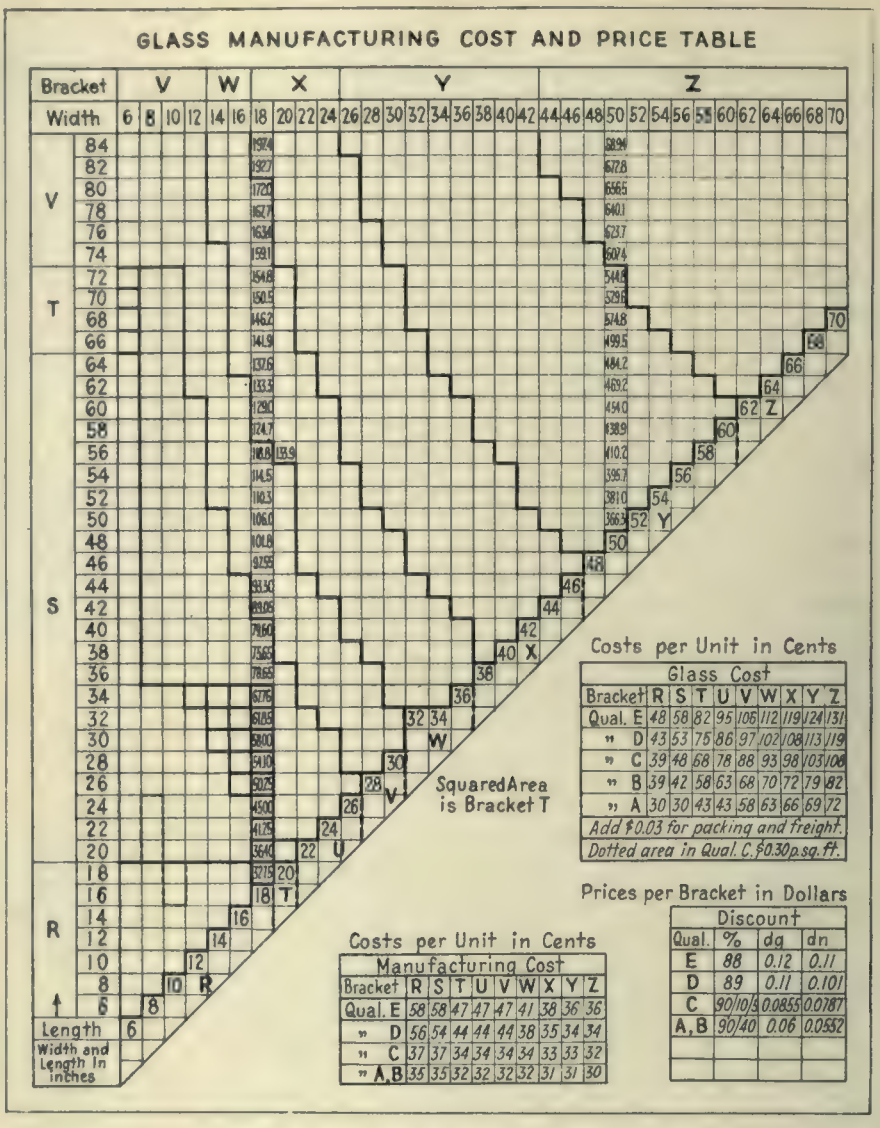

GLASS MANUFACTURING COST AND PRICE TABLE
Bracket
Width
V
W
X
Y
Z
Length
Width and Length in inches
Squared Area is Bracket
Costs per Unit in Cents
Glass Cost
Qual. E 48 58 82 95 106 112 119 124 131
" D 43 53 75 86 97 102 108 113 119
" C 39 48 68 78 88 93 98 103 108
" B 39 42 58 63 68 70 72 79 82
" A 30 30 43 43 58 63 66 69 72
Add $0.03 for packing and freight.
Dotted area in Qual. C, $0.30 p. sq. ft.
Costs per Unit in Cents
Manufacturing Cost
Qual. E 58 58 47 47 47 41 38 36 36
" D 56 54 44 44 44 38 35 34 34
" C 37 37 34 34 34 34 33 33 32
" A, B 35 35 32 32 32 32 31 31 30
Prices per Bracket in Dollars
Discount
Qual. % dg dn
E 88 0.12 0.11
D 89 0.11 0.101
C 90/10 0.0855 0.07187
A, B 90/40 0.06 0.0552

FIG. 1 GLASS MANUFACTURING COST AND PRICE TABLE

SYMBOLS

l = Length
w = Width
gl = Glass cost list
ml = Manufacturing cost list
pl = Price list
dg = Gross discount
dn = Net discount

FORMULAS

Size: $S = l \times w \times 0.00694$
Glass cost: $G = (l \times w \times 0.00694)(gl+3)$
Manufacturing cost: $M = (l \times w \times 0.00694)ml$
Total cost: $C = (l \times w \times 0.00694)(gl+3+ml)$
Price gross: $Pg = pl \times dg$
Price net: $Pn = pl \times dn$
Profit gross $= pl \times dg - (l \times w \times 0.00694)(gl+3+ml)$
Profit net $= pl \times dn - (l \times w \times 0.00694)(gl+3+ml)$
Percentage of net profit $= 100 - \dfrac{(l \times w \times 0.00694)(gl+3+ml)}{pl \times dn}$

$$\text{Per Cent} = \frac{\text{Gain}}{\frac{Pn}{100}} = 100 \times \frac{\text{Gain}}{Pn} = 100 \times \frac{Pn - C}{Pn}$$

$$= \frac{100Pn}{Pn} - \frac{100C}{Pn} = 100 - \frac{100C}{Pn}$$

$$\text{or Per Cent} = 100 - \frac{(l \times w \times 0.00694) \times (gl + ml + 3)}{pl \times dn}$$

Table 1 compares the old and the improved methods of figuring and shows the simplicity of the new.

Building and Starting the Tool Crib

Methods at the Worthington Works

By ANKER L. CHRISTENSEN

Engineer, Tool and Material Storage Department, Worthington Pump and Machinery Corporation

WHEN the location of a tool storage room has been decided on, and a method of tool classification and arrangement has been worked out,[1] it is necessary to settle details of the bins and the procedure to be followed in putting tool control into effect.

Tool cribs are seldom left where they are originally placed. In order to facilitate moving and rearranging a crib, bins and racks should be so arranged and standardized that all parts are interchangeable. The size and shape of the crib unit may vary, in different factories, but the following general rules should govern:

1. All units of the bin system should be of the same size.
2. Units should be small enough to be easily handled.
3. The main compartments should be of the same size. This will facilitate moving tools from one bin to another by simply moving the interior racks and shelving.
4. Bin units should be so designed that they may be fitted into any shape and size of room with the greatest economy of space possible.

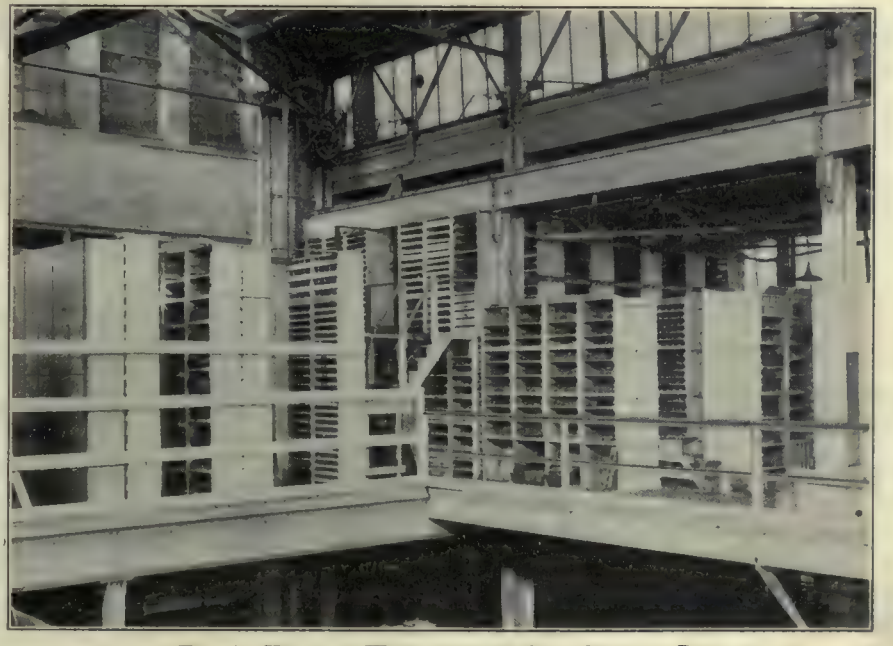


FIG. 1 VIEW IN WORTHINGTON TOOL STORAGE ROOM

Gilbreth Standard Wood Bins. The wood bins, worked out on the principle of the sectional bookcase idea by Frank B. Gilbreth, fill the requirements for an ideal bin as nearly as is possible with wood construction. Fig. 1 is a photograph of a section of these bins in the Worthington Works tool room, and Fig. 2 shows the details of construction. Fig. 3 shows the types of racks used for different kinds of tools. It will be noted that the inside dimension of each section is 24½ in. each way. When this bin is placed on its side it covers 51⅝ lineal inches of floor space; if set on end, only 26¼ in. All bins are 17 in. in depth. By a combination of bins lying flat and standing up, almost any space can be filled with bins to good advantage. The slats on the back are so arranged that when two boxes are set back to back they match one into the other, forming a solid back for the bin. (See Fig. 1.) Interior racks and shelves, for the individual tools, are all made so that they will fit into a space 24½ by 24½ by 17 in. deep.

However, these racks have some inherent disadvantages, that is to say:

1. Wood construction has a very high fire hazard.
2. Wood bins are hard to keep clean because of rough surfaces and disfigurement of the paint.
3. The scrap value of these bins is practically nil.
4. Wood construction takes up a great deal of the space, sometimes 20 per cent.

Pressed Steel Bins. The use of pressed steel storage bins has become general during the last few years. They have a few striking advantages over wood bins, namely:

1. Their fire hazard is low.
2. They are easy to keep clean.
3. They are more economical in the amount of space occupied, in that the bin construction does not take up more than 5 or 6 per cent of the total space, as compared with 20 per cent for wood.

[1] See MANAGEMENT AND ADMINISTRATION, May 1925, pp. 467-470.

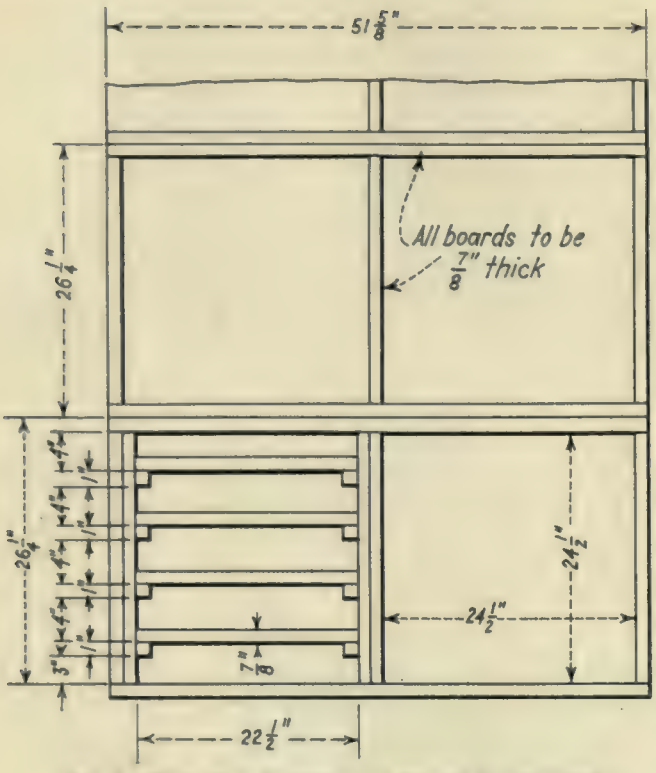


FIG. 2 WOOD BIN DESIGNED BY FRANK B. GILBRETH

On the other hand, they have some disadvantages which should be considered:

1. Side panels are usually made the full height of the bin, which cannot be added to nor reduced to suit requirements.
2. They are awkward and expensive to move.
3. Their cost is relatively high.
4. Their scrap value is very low.

Combination Cast-Iron and Wooden Bins. Where a factory has its own foundry, a good form of bin can be made by using cast-iron side pieces and wood shelves, as shown in Fig. 4. All the sides are made from one pattern. To assemble the bin, two boards are laid on the floor, running the full length of the bin; the cast-iron uprights are then set on these boards at equal distances and fastened by lag screws. Another course of boards is then laid on the castings, and on these is placed a second set of uprights. The center and base boards are left 1½ in. apart in the center of the rack to allow for bracing the bin when necessary and also for filling in back partitions when only one-half of the bin is needed.

The advantages of this type of bin are:

1. Low initial cost.
2. Facility in setting up and taking down.
3. The space occupied by the bin construction is low—about 5 per cent.
4. The unit compartments, which are 24 by 51 in. and 36 in. deep, can readily be divided into any number of subcompartments and sizes.
5. The scrap value of these bins is very high, as the iron can be remelted when discarded.

So much for general bins. There will be a great many racks for special tools that will not fit in the standard bins. They should be designed to suit the tools in question, always trying to keep the floor space dimensions the same as those of the standard bins.

Desk and Clerical Equipment. A desk and chair for the convenience of the tool crib foreman are necessary. The desk should be located as near to the issuing window as is convenient, so that the foreman can keep a close watch on the workings of the tool crib in general, and be as near outside communication as possible.

Marking Equipment. All tools should be plainly marked with the tool symbols and sizes in a conspicuous place. Several sizes of steel letters and figures should be provided for this purpose. Etching is necessary for very hard or delicate tools, but stamping is generally more satisfactory, and should be used whenever possible. Each tool compartment should be marked with a metal tag which gives the identical information marked on the tools themselves. Standard metal tape embossing machines may be provided for this purpose.

The White Tool Crib. A tool crib painted white not only has a clean appearance but also cuts down the amount of light needed. In order to make the painting uniform, an order should be issued that nothing but white paint is to be used except by special permission.[2] If this rule is not adhered to, a variety of shades and colors are likely to be found in the painted portions of the crib, thereby defeating the purpose of the painting and marring its general appearance.

FIG. 3 TYPICAL SECTIONS OF TOOL SHELVING

The transfer of tools from the various departments should be done as quickly as possible. It requires careful planning, and tact and diplomacy in its execution.

One method is to start with the abraiding and follow with the blanking tools, just as they are arranged in

[2] See *Iron Trade Review*, October 20, 1921, pp. 1004-1006. "Reducing Fatigue in Tool Rooms," by Frank B. Gilbreth and L. M. Gilbreth.

the symbol book. Another method is to attack the tools of most importance first. Gages are usually the most important class of tools in a factory, and, besides, there are generally better records available for them than for other tools. Storage space for gages and

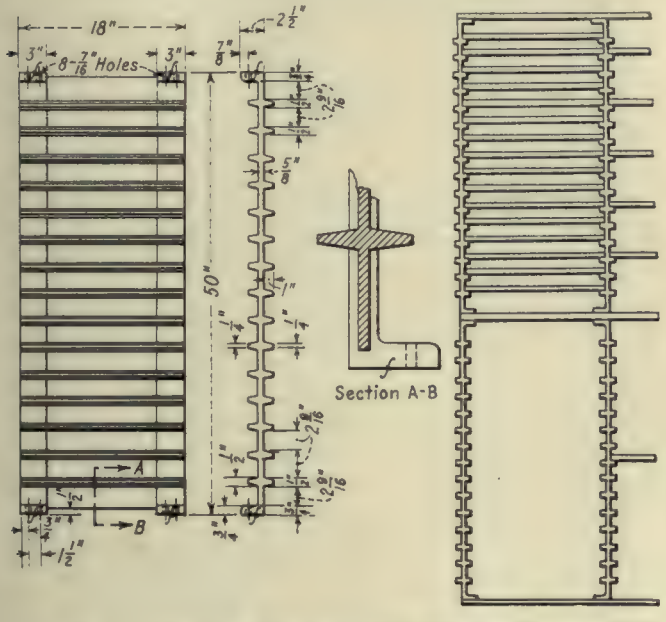


FIG. 4 CAST-IRON RACK FOR TOOL STORAGE SHELVING

other tools used often should be as near the tool issue window as possible. (See Fig. 5.)

Location. Each bin should be marked with the symbol and size of tools it contains. This marking should be visible to the man of average height. For this purpose, bevel the edge of the bin and place all boards that are below 5 ft. from the floor with the beveled edge up, and all those that are more than 5 ft. 10 in. above the floor with the beveled edge down. Tack the bin tags on these beveled edges. Bin tags should be uniformly fastened to the bin. Check hooks should always be in the same relative position to the bin tags. A good rule to follow is that all hooks should be next to and at the right side of the tags.

Tools whose sizes are in fractions of an inch should be placed in the bin in such a manner that the succeeding fractions of 1/4 in., 1/8 in., and 1/16 in. will come in the same relative position, i.e., twist drills are made in increments of 1/64 in., and should be arranged on the racks in such a manner that the even 1/16 in. or 1/8 in. or 1/4 in. sizes will be in a vertical line on the left side of the bin. Likewise, number drills should be arranged in groups of fives or tens.

Facility in Handling Tools. Tools should be stored and bins marked so that:

1. A man standing in the main aisle can see at a glance all the tools that are stored in any particular section, or bin.
2. All individual tools are easily accessible and can be removed from the rack in one operation.
3. Working edges, or that part of the tool that is most frequently out of repair may be easily seen, i.e., paring tools, such as forged planers, should have their cutting edges out.
4. Each tool and its bin space should be identically marked.
5. Fine tools that are kept for inspectors or tool makers should be locked in special lockers and given out only on written order of the tool room foreman.

Expansion Space. Standard bins are stacked four compartments high, and, by leaving the top compartment empty, an expansion space of 25 per cent is provided. In case this extra space is not needed, the tools may be stored only 6 ft. high where they can be reached easily by a man standing on the floor.

Tool Inventory. Records are necessary in order to keep a shop properly equipped with complete sets of tools. The initial records should be made at the time the tools are taken into the crib. Any record system that functions properly should show the following information at all times:

1. How many tools are on hand, and how many on order.
2. Where the tools are, and who has them.
3. What condition the tools are in.
4. When tools are damaged, lost, or worn out, show what the attending causes were.
5. What is the tool consumption per item, for a certain period.

Records that will adequately furnish the data mentioned above may be kept in several ways. One good method is to keep the permanent information on a sheet as shown in Fig. 6. The quantities listed on this form are those that the tool crib are authorized to keep in stock at all times. Sizes are listed in order, from smallest to largest.

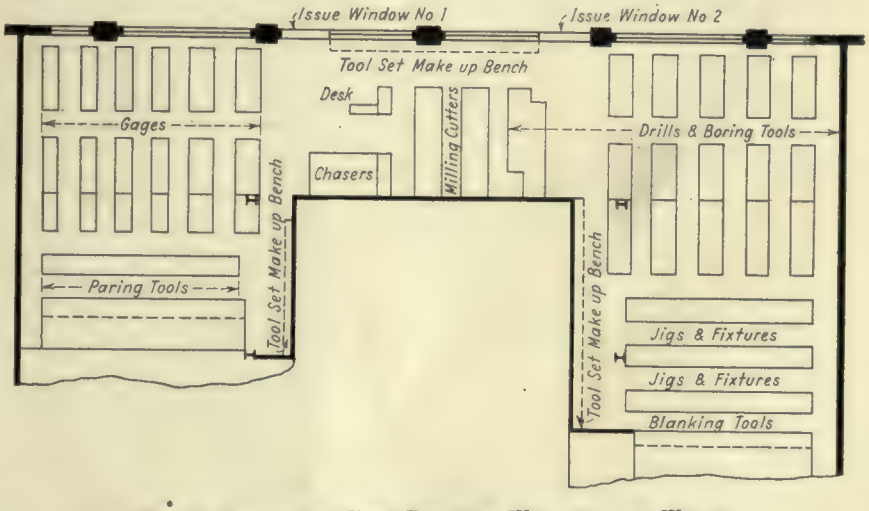


FIG. 5 LAYOUT OF TOOL ROOM AT WORTHINGTON WORKS

When deciding on the definite quantity of tools to be maintained in stock, each individual item should be studied in the light of the following considerations:

1. What is the monthly consumption of each item?
2. What is the time period between placing orders and receiving tools? Many tools are carried in stock by tool makers, on which immediate shipment can be made; others have to be made to special order and the period between ordering and receiving goods is sometimes months.
3. Is the consumption of tools constant, or is there seasonal variation?
4. What are the economical purchasing units?
5. Is the nature of the tool such that it is cheaper to buy and carry a stock in the storeroom for issue to the tool crib as needed?

In this connection it should be borne in mind that there are seasons of the year when tools can be bought to better advantage, i.e., at greater discounts and better terms can be secured; and there are also frequent opportunities to fill requirements at liquidation sales of bankrupt concerns.

When the number of tools to be carried in stock in each group has been properly ascertained, the making and checking of purchase requisitions becomes a matter of routine.

The inventory sheet shows the unit value as well as the total value for each item. This record of tool values has several advantages:[3]

1. The value of tools on hand can be obtained readily by simply adding up extended prices in the Total Price column.
2. A definite and fixed price is set, which can be referred to when tools are broken and must be charged to the workmen.
3. Few workmen realize the value of tools. But if they are impressed by the fact that a very small tool may cost considerable money, the spirit of carefulness and consideration for the employer's interest is established.
4. Unit prices form a basis for fixing the value for the standard tool kits that are issued to men in the shops, such as assemblers, erectors, etc., and the general tools issued to mechanics.

Tools are not everlasting. They are broken, worn out, lost and stolen. If these losses are noted on the perpetual inventory sheet, it will soon become so cluttered up with marking and changing that it will be valueless as a record. To obviate this condition, a "balance of tools" form has been devised, Fig. 7. This record is maintained on the principle of a simplified stock ledger sheet, i.e., deduction and addition to the number of any tool items are made in the same way as on stock ledger cards.[3] "Standing orders," or written instruction sheets, should be prepared, stating in detail the methods of filling out and using both the perpetual inventory and balance of tools sheets.

Writing Off Tools. When it becomes necessary to retire a tool from service because it is broken, worn out, or impaired through any cause, the foreman who is responsible for the tool at the time should fill out a "broken tool report" and send it to the tool crib, together with the damaged tool.

As a final precaution, frequent inventories should be taken. This may be done by having two men work together, one counting tools in the bins, while the other checks them off on the balance of tools sheets. If there are discrepancies, the tool sheets should be adjusted to correspond with the physical inventory.

(To be continued in the July issue.)

[3] See *American Machinist*, August 30, 1923, pp. 329-334, "The Tool Room and Its Place in Production," by K. H. Condit.

PERPETUAL INVENTORY OF TOOLS IN TOOL ROOM

Price Rud Munn Examined Albert Schauer
Extended J H Howard Approved O Christenson
Department Main Crib
Symbol DDTTHR
No. of Sheets 5
Sheet No. 3

Quantity	Size or Weight	Description	Remarks	Price per Unit	Total Price
6	1 1/16	Taper Shank Drills R.H. High Speed Fractional		12 00	72 00
6	1 49/64	" " " " " " "		12 50	74 00
6	1 23/32	" " " " " " "		12 50	74 00
5	1 47/64	" " " " " " "		13 00	65 00
8	1 3/4	" " " " " " "		13 00	104 00

FIG. 6 STANDARD SHEET FOR PERPETUAL INVENTORY

BALANCE OF TOOLS

DESCRIPTION Taper Shank Drills R.H. High Speed Fractional
Symbol DDTTHR
No. of Sheets 103
Sheet No. 45

Size 1/16 Max No 6 Min No 4 No to Order 2						Size 1/16 Max. No. 6 Min. No. 4 No. to Order 2						Size 1/16 Max. No. 6 Min. No. 4 No. to Order 2						Size 1/16 Max. No. 6 Min. No. 4 No. to Order 2					
Date Ord'd	No of Pieces	Purchase Order No	Date to be Delivered	Date Rec'd	No of Pieces Damaged	Date Ord'd	No of Pieces	Purchase Order No.	Date to be Delivered	Date Rec'd	No. of Pieces Damaged	Date Ord'd	No of Pieces	Purchase Order No.	Date to be Delivered	Date Rec'd	No. of Pieces Damaged	Date Ord'd	No of Pieces	Purchase Order No.	Date to be Delivered	Date Rec'd	No of Pieces Damaged
	14	Inv.		12/14	𝍸 𝍸 𝍸 𝍸 𝍸																		
1/2/24	2	9344	1/2	1/3																			
1/7	4	WQ2230	1/10	1/20																			

FIG. 7 STANDARD SHEET FOR SUPPLEMENTING PERPETUAL INVENTORY BY RECORDING PURCHASE AND DAMAGE OF TOOLS

Gaining the Workers' Confidence

Man-to-Man Dealings Adopted by Prominent Industries

By P. F. WALKER

Dean, School of Engineering, University of Kansas

I HAVE recently completed an inspection trip extending through a period of several weeks and covering several of the largest industrial centers of the country, giving special attention to management and personnel matters.[1] Plants visited have varied in size from those employing only 200 or 300 men to those employing many thousands. The articles produced in these plants range all the way from the small parts of telephone sets to the largest sizes of dredging and excavating machinery, 50,000 kw. turbo-generators, and corresponding articles.

My aim was to learn what methods were employed by managers of industries in handling the human element. One cannot but be impressed with the change which has taken place in the last 15 years. Without exception, the executive in charge of operations is now showing a decided interest in personnel problems, and each one has mapped out a definite line of procedure.

It is significant that practically no two of these managers agree in detail as to the method of procedure. Where one may believe in works councils another may be diametrically opposed. The same may be said about various other systems or methods frequently employed in manufacturing establishments.

Employment Methods

All are bent on securing genuine co-operation of spirit from the wage-earners, to reduce labor turnover and increase production. In every one of the plants visited, the management expressed the conviction that these results are being secured.

Surprising as it may appear, all of these companies have not developed systematic methods for listing and classifying applicants for employment. Many of them keep lists of names of all who have left the works at times of depression or partial shut-down, and the desirable ones are taken back as soon as conditions permit, provided they are then available. A few concerns have gone further than this in the way of maintaining waiting lists.

Increased attention is being given to training of apprentices as a means for recruiting the ranks of labor. The industries have come to realize that they must do the training if a sufficient number of competent men is to be available as the years go on. In a measure this has paralleled the passing of the labor union in the machinist and allied crafts, but it is not of necessity dependent upon it. The union, apparently, has become unnecessary as an agency protecting the rights of the workers under more enlightened management. Only one of the ten companies opposes the union. The others are not concerned whether the men belong to it or not.

Wage Systems

In the plants visited the wage systems employed include the straight time or day rate plan, straight piece work, day rate with bonus, and piece work with bonus. This represents a fairly complete range of wage payment practices. Every one of these establishments is confident that it is securing excellent results. There is good reason to believe that each one is justified in this opinion.

In several of the establishments there is in force some form of financial incentive other than wages. These include various forms of benefit plans, pension regulations, and special methods whereby employees may acquire company stock. One concern reports 90 per cent of its employees as subscribing for stock; another 60 per cent. One firm has in vogue a system whereby it distributes to superintendents, foremen, and others of the supervisory force certain portions of company earnings which remain after definite reserves have been set aside. The general idea of bringing wage-earners into a substantial relationship with the company is gaining ground.

Works Councils

In four of the establishments visited the works council has been developed in a fairly complete and satisfying manner. The four plans are not dissimilar, aside from certain differences in the basis of representation in accordance with which the members sitting on the council are selected. The motive in each case is the same, namely, to bring the workers into contact with the active managing heads of the industry, and to have transmitted back to the working force much vital information respecting the condition of the business. In one establishment, committees of the council are named, having to do with manufacturing methods, safety and sanitation, bonus complaints, and welfare. One of the other companies has only a single committee, which takes up special individual grievances submitted by workers.

As a substitute for the works council, in one establishment employing approximately 1500 people, the

[1] The companies referred to are: Allis-Chalmers Mfg. Co., American Steel and Wire Co., The Bucyrus Co., General Electric Co., International Harvester Co., Johns-Manville, Inc., Nash Motors Co., Sullivan Machinery Co., Union Special Machine Co., and Western Electric Co.

president and active manager hold a general assembly at certain intervals for the purpose of laying before the workers the economic facts pertaining to the industry.

In about half the plants visited, careful attention is given to suggestions from workers. It is a fact universally observed that, where the suggestion idea persists at all, it has been fostered by carefully developed methods, whereby the rights of those who pass in suggestions are protected. Unless qualified and disinterested members of the company's staff are assigned to the duty of examining and checking the ideas presented by the men, the system becomes a farce.

Educational Methods

With only two exceptions, all of the concerns visited have adopted specific measures for carrying to their employees the essential economic facts of the business. The means vary from the one meeting of the year where the general manager addresses the entire group on the business outlook, to elaborate plans for the meetings of works councils and other groups, particularly apprentices and others who are in special training, for a systematic study of business economics.

Of course the information given out may be "doctored," so that some may scoff at the idea. The opinion is ventured, however, that the manager who attempts to distort the facts of his business, and to serve them up to his employees in that way, will find himself in troubled waters before he has progressed very far. The intelligence of the average American workman, particularly in the metal working branches of industry, is of a grade such that few of them can be fooled for any considerable length of time. The manager who is not ready to present facts in their true, unvarnished forms, meeting the men with sincerity, will be wise if he refrains from all thought of adopting this form of education.

Campaigns for Special Objectives

In three of the establishments visited special campaigns have been instituted during the current year for reducing overhead charges and certain forms of waste. One of these companies is saving thousands of dollars this year by the simple process of cutting down on the unnecessary consumption of water. Along with this, attention is being centered on wastes of many of the simple materials handled every day by the workers. The campaign has been laid out as carefully as are those conducted by professional promoters of public enterprises where concerted action of masses is secured by spread advertising and cleverly devised propaganda. It so happens in this particular company that more than 50 per cent of the workers are stockholders, which furnishes a leverage and an effective incentive. It is of interest to note that substantial savings are realized in the printing bills. Forms and cards have been standardized by the establishment of a rule whereby every request for a new form must pass through the hands of one man, whose business is to standardize and simplify it.

Another large company, operating several plants, has saved hundreds of thousands of dollars through the adoption of standard practice regulations, through which the several plants have been required to adopt uniform specifications for steel and other materials, and to unify their production activities in various other ways.

There is one characteristic common to all the plants whose methods have been observed in this brief review. Radically as they differ in many of the details, they are alike in this respect—in making prominent the principle of the "square deal." Confidence in the management is the essential element in securing genuine co-operation, and it appears that all of these ten concerns are bent on securing this co-operation through a policy of square dealing.

Confidence the Basis of Co-operation

At one shop, where straight piece work is employed, the necessity for increased production developed. One particular spot was the "neck of the bottle" where a vital task was performed and where production had to be hastened if the objective was to be realized. Various efforts were made by the management to hasten the work at this point but without success. Finally, in his characteristically frank way, the manager said to the men, "We have proposed various ways by which you might increase your output but without result. We are now ready to receive a proposition from you. Think it over and tell me what you will do." The answer from the men was directly to the point. They said, "Cut our rate on this job from $1.10 to $0.92 and we will get out the work." They did it. In the same plant, under quite different circumstances, another man made specific request that his rate be cut.

Such proposals do not come in a plant where there is not implicit confidence on the part of the men that their rights will be respected. The manager here emphasizes his desire that the men shall make high wages, and they do make high wages. He guarantees that no rate will be revised downward unless with the agreement of the workmen. Before the works council at every monthly meeting he gives a straight account of the business of the company, explaining the economic situation which may have affected the volume of business, dealing with them in a frank and open manner. This is not an isolated instance, but it is expressive of a central principle.

The conclusion from such a survey is that management is largely a matter of personality and systematic purpose—not one of rules or technique. Workmen everywhere are rising to a higher level of intelligence and of ability to interpret the facts of industry as well as the principles of government. More and more, successful management will recognize this condition. There are evidences that the old form of labor domination is passing. It will pass as the men who make up the rank and file of labor acquire a feeling of confidence that those under whose orders they work have a real regard for their welfare and respect for their opinions. In such ways there are evidences of advancement in the management of manufacturing industries.

New Type of Material Control Record

Requires Minimum of Effort to Operate, for It Is Concerned Principally with the Exceptional and Irregular Occurrences

By RALPH E. CASE

Stevenson Harrison and Jordan

An overall material controlling account is, like Caesar's Gaul, divided into three essential parts: purchases of materials, sales to customers, and waste, or, in the dealer's language, junk. A certain amount of purchased material will eventually leave a manufacturer's possession either as a sale to a customer or as scrap. In all probability both routes will be used, the major portion leaving as finished product and a minor portion as scrap. Since it is true that material enters a factory by one route and leaves by two other routes, we may lay down a principle upon which to base a control.

Principle of Material Control

If the Material Controlling account is debited with the value of all materials purchased and credited with the value of materials in sales to customers and in scrap produced, the balance will truly represent the value of material in the possession of the manufacturer.

The writer recognizes that there are many kinds of wastes and losses which cannot be obtained in any simple and practicable manner. For example, the steel dust which is ground from the file blank, or the scale from a forging, mentioned below, the invisible loss of cotton in a yarn mill due to lint, humidity changes and other causes, the evaporation of liquids, and many others. Nevertheless, losses such as these can be determined by a special investigation and, once having been determined, become a part of the standard specification for the article manufactured. This brings forward a second principle as follows:

Any article for which engineering specifications have been laid down must contain a definite amount of material, and the fact that such an article has passed inspection automatically accounts for this definite amount of material.

If the article being manufactured is a telephone receiver, the shipment of a complete tested receiver must account for a very definite amount of various materials. Obviously, if there is no diaphragm to transform the electrical oscillations into acoustic vibrations, it is not a receiver. Neither is it a receiver if the case or a magnet, or the smallest screw called for in the engineering specifications, is omitted. Further, a receiver will not pass the scrutiny and tests of the inspection department if there is the slightest deficiency of material. It follows, therefore, that the fact of having shipped a receiver that has passed inspection automatically accounts for a very large proportion of all the material used in its production, if means are provided for recording this available information. No further detail is necessary for the control of the great bulk of the material.

To complete the control of material, it is necessary to record in some detail the relatively small amount of waste. This is the missing link, the exception, but by carefully recording this data we eliminate the necessity of detailed records regarding all the rest of the chain. And since the bulk of the material is accurately recorded on the basis of standard specifications, the chance of any large discrepancy is materially reduced, since it must occur in the relatively small amount of scrap. Suppose that scrap amounts to 10 per cent of all material, and then suppose that records covering as much as 10 per cent of all the scrap are lost. What is the result? The material records as a whole are in error 10 per cent of 10 per cent or only 1 per cent. This in a measure expresses the third principle—that of exceptions.

Principle of Exceptions

A very efficient control can be exercised with a minimum of effort by carefully accounting for the exceptional and irregular.

Now, what is the result of applying these principles to the construction of a material controlling account? Simplicity is the first advantage, since use is made of the existing records of incoming and outgoing invoices for the great bulk of the material, and detailed records are necessary only for waste. The pricing of individual requisitions, the machinery necessary to insure against the loss of requisitions, the various internal transfers with their inherent changes in units, nomenclature and many kindred details are avoided. The second advantage is a probable gain in accuracy since the major portion of the record is based upon carefully kept records, and so many detailed records are avoided that the chances of error are greatly decreased. A third advantage is the practically independent source of the information from which this control of the details is obtained.

To illustrate the operation of such an account, consider a simple article such as a file. In Fig. 1 are illustrated the four principal steps so far as material is concerned in the manufacture of a 7-in. regular pillar file.

A steel bar is first cut into blanks as shown at *A*.

This is the exact amount of steel which is necessary in making the file in question, and for the purposes of this discussion it is assumed that 100 of these blanks will weigh 19 lb. In shearing a bar into blanks, there is a certain loss due to the fact that the bar is scarcely ever exactly divisible into an even number of blanks. An end or ends are wasted and must be accounted for. The sheared blank is next forged, as shown in *B*, in which condition it has been given the proper taper at both ends and the tang end has been considerably flattened and spread out. There is practically no loss of material in this operation with the exception of a slight amount of scale.

In the next operation, shown at *C*, the tang has been punched, leaving the blank in proper form for grinding and subsequent operations, and making a definite amount of waste, as indicated by the two pieces which have been cut from the original blank. This waste should be accounted for. In the condition shown in *C* we find that 100 blanks weigh 15 lb. In other words, there is a definite loss of material between the sheared blank and the blank ready for grinding of 4 lb. per 100 pieces. At *D* we have the finished file, which would weigh approximately 11½ lb. per 100 pieces, showing a further loss of 3½ lb. Whereas, the former waste of 4 lb. is very definite and easily accounted for, the 3½ lb. of waste cannot be easily accounted for, because it is principally the result of

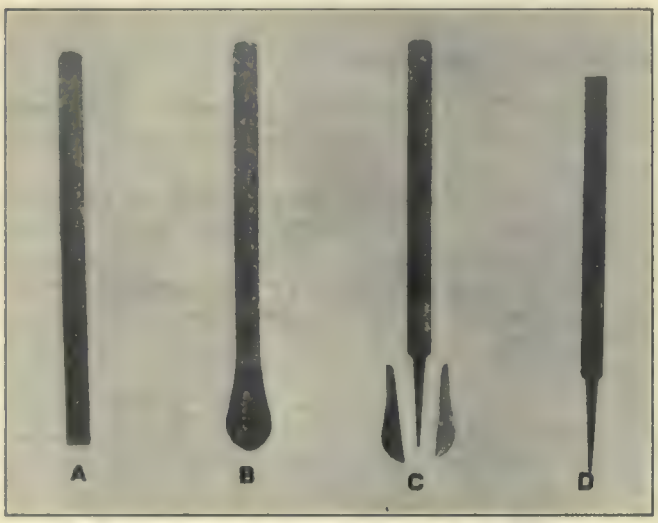


FIG. 1 STEPS IN MANUFACTURING A PILLAR FILE

grinding and filing, and the particles thus removed cannot be separated or measured in any practical manner.

It would, therefore, be necessary in the manufacture of this file to take a standard specification of material as it appears at *C*, that is 15 lb. per 100 pieces, rather than the finished weight of 11½ lb. per 100 pieces. In this way the waste which cannot be easily measured is taken care of very accurately since it is absolutely necessary to use the blank as shown at *C* in the construction of the finished product. Therefore, the sale of 100 7-in. regular pillar files automatically accounts for 15 lb. of material, and if to this we add the scrap made in punching the tangs and the scrap made in shearing the blanks, we will have the exact amount of material actually used in the manufacture of 100 files. As a matter of fact the blanks could be used as a basis and account kept of the cropped ends only, except that the above method gives an opportunity to check any excess waste in the forging and punching departments.

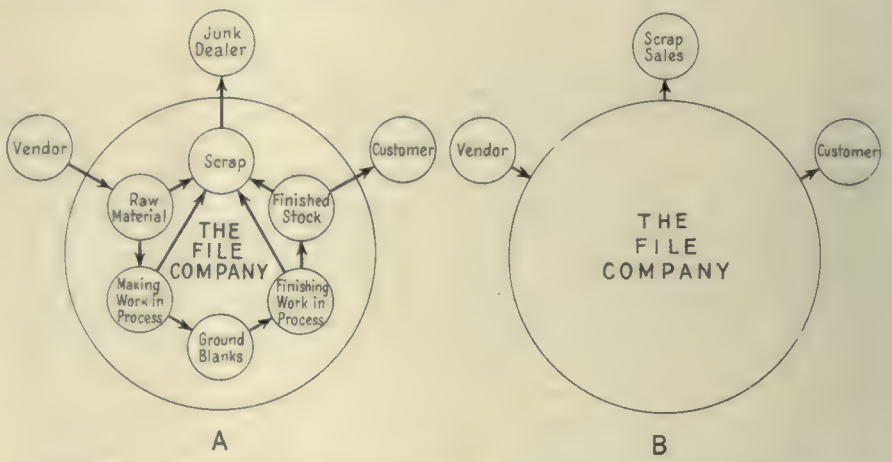


FIG. 2 A—DETAILED MATERIAL RECORDS. B—MATERIAL CONTROL RECORDS

The major accounts that would ordinarily be used in the manufacture of files are illustrated in Fig. 2A. It will be noticed that there are three stores accounts as follows: Raw Material, Ground Blanks, and Finished Stock. In addition to the stores accounts, there would be two work-in-process accounts: Manufacturing (called "making" in Fig. 2A), and Finishing. The Manufacturing might be divided into Shearing, Forging, Annealing, Straightening and Grinding. The Finishing might be divided into Stripping, Cutting, Etching, Marking, Hardening and Inspecting. Even without these latter subdivisions, the number of records due to internal transfers of material is quite considerable, as indicated in Fig. 2A. The chances for errors are also quite considerable, not only in the making out and recording of the requisitions and other orders forming the basis of these transfers, but also in another manner which is rarely taken into consideration.

If a discrepancy is found in the ground blanks stores, for example, it is usually adjusted without any regard to other accounts which may be considerably affected. The discrepancy may be due to partial deliveries from manufacturing work-in-process or partial deliveries to finishing work-in-process or to salvaging operations on blanks which did not pass inspection or a number of other causes that might be mentioned. The adjustment of the ground blanks stores does not properly adjust the materials accounts. It must be remembered that there are several thousand different files, and the problem is further complicated by changes in nomenclature and the disconcerting habit of file makers, like bakers, of counting 13 to the dozen.

How can these materials be simply and accurately

controlled? Fig. 2B indicates the application of the principles laid down in the opening paragraphs of this article. A special form of material controlling account in which both quantity and value may be entered would be provided. Debit this account with the quantity and value of all materials purchased. Credit this account with the standard quantity and cost value of the materials in all shipments. This will be obtained by extending the invoices to customers at the standard specification quantities and the average actual cost value. For example, a shipment of 100 dozen 7-in. regular pillar files would be figured as follows:

$$1200 \text{ files} \times 15 \text{ lb. per } 100 = 180 \text{ lb.}$$

The total quantity for a month is footed and extended at cost value for crediting the controlling account.

Whatever sales of scrap have been made are also credited to this account, posting both quantity and cost of the scrap. Spoiled or rejected files must be considered as scrap, and if they cannot be salvaged, must become a credit to the Material Controlling account in the same manner as sales to customers, i.e., by determining the amount of material used to make the rejected file. Labor and other expenses lost in the spoiled work form no part of the material record.

Fig. 3 summarizes the principles outlined above. The balance of this account will show the total amount of material in the possession of the company and the total value thereof, and such detailed records as are necessary for the routing and control of materials in the factory may be kept in quantities only and will not need to be priced except at such times as some special check with the controlling account is desired.

To reduce the principles which have been outlined

MATERIAL CONTROLLING ACCOUNT

Quantity	Description	Amount	Quantity	Description	Amount
Debit	*Quantity and amount from Vendors bills for materials received*		Credit	*Specification quantity and cost value of all materials shipped by the company to customers.*	
			Credit	*Actl. quantity and cost value of all scrap disposed of.*	

FIG. 3 MATERIAL CONTROLLING ACCOUNT

to definite working detail, an illustration has been developed in the diagrams for a concern making drop forgings. In this example, the inspection report has been used instead of the sales to illustrate another method of applying the principles laid down.

A typical forging in the various stages of manufacture is illustrated in Fig. 4. At *A* we have a piece of 1¾ by 1¾ in. steel that has been sheared to the proper length to make a forged yoke. At *B* is shown the forging as it comes from the drop hammer. There is no change in the amount of material, except for scale, since the original bar has simply changed shape, the major portion appearing in the forged yoke and the balance in the flash. At *C* we have the flash that has been trimmed from the forging and at *D* we have the finished yoke.

The weight of *A* is 4 lb. The weight of *C* is 1.1 lb., and the weight of the finished forging is 2.8 lb. There is a definite measurable waste of 1.1 lb. and a further loss of 0.1 lb. due to scale. Therefore, the production

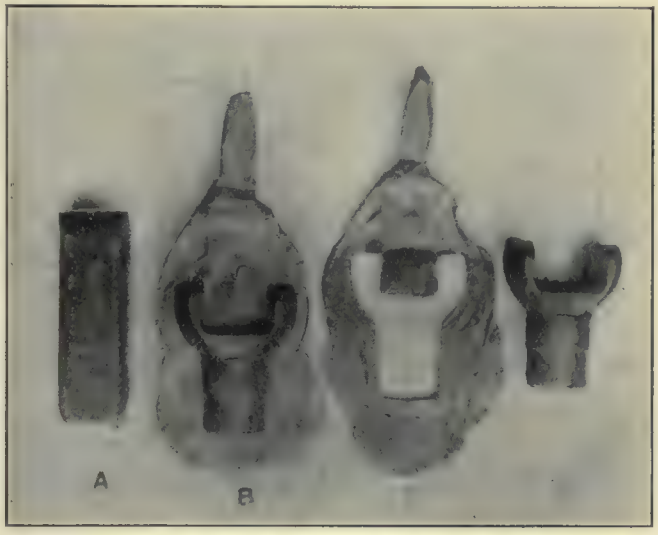


FIG. 4 STEPS IN FORGING A STEEL YOKE

of 100 yoke forgings accounts for 400 lb. of 1¾ by 1¾ in. iron, and to complete the material control it is only necessary to account carefully for excess waste and rejected forgings. To get the figures for excess waste as a credit to the controlling account and as an index of the efficiency of use of materials, it is necessary to keep records of the total waste made.

Fig. 5 covers the debit side of the Material Controlling account with the various details leading up to the entries. These, of course, are hypothetical, and many details are subject to various treatments, but the underlying principles would be unchanged. For example, it is not always possible to charge a drayage bill entirely to one size of steel or even entirely to productive materials. However, such details are satisfactorily met in the ordinary course of any business, and the various methods need not be covered here.

Form A represents an invoice for a carload of 1¾ in. square steel for making the yoke. The quantity of 35,800 lb. covered by this invoice is, of course, checked up, as indicated by line 1, with the receiving record, Form B, before being passed for payment. As such invoices are passed for payment, they are tabulated on any convenient tabulating form, such as E, under whatever classification of materials it is deemed necessary to obtain the desired results. In the example, each size of steel is recorded separately. Connecting line 2 therefore indicates the tabulation of the quantity of 1¾ by 1¾ in. steel bars received and line 3 represents the tabulation of the cost of this steel.

There is also a freight charge for this carload of steel which is considered a proper charge to the cost of the material. Consequently, the freight bill when received and identified is also entered on the tabulating sheet in the Amount column but without any corresponding quantity, since this is merely an increased cost of material already received. This entry is indicated by line 4 on the diagram. Incoming drayage charges may

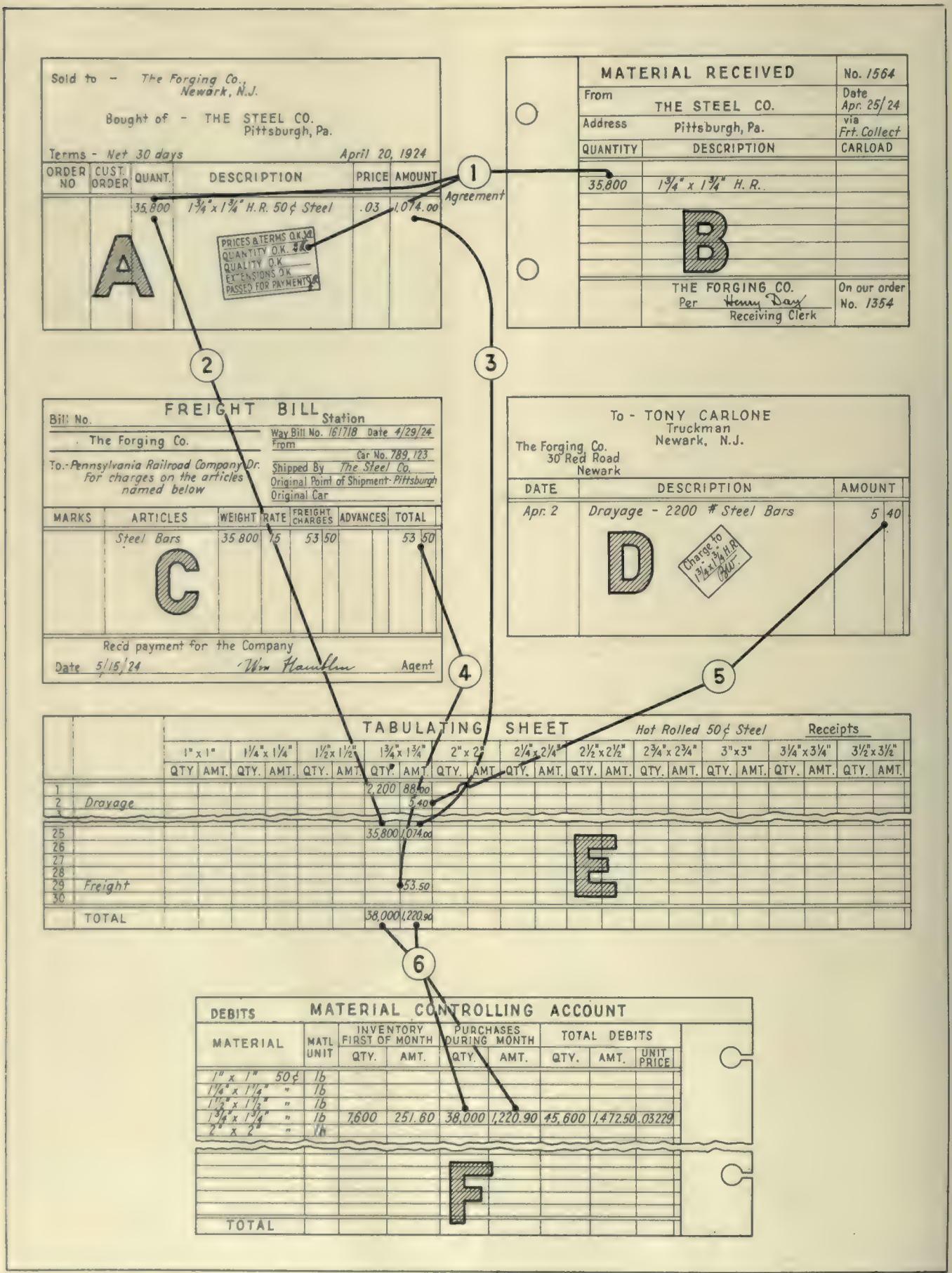

Sold to - The Forging Co., Newark, N.J.
Bought of - THE STEEL CO. Pittsburgh, Pa.
Terms - Net 30 days
April 20, 1924
ORDER NO | CUST. ORDER | QUANT. | DESCRIPTION | PRICE | AMOUNT
35,800 1¾" x 1¾" H.R. 50¢ Steel .03 1,074.00
PRICES & TERMS O.K.
QUANTITY O.K.
QUALITY O.K.
EXTENSIONS O.K.
PASSED FOR PAYMENT
A
1
Agreement
MATERIAL RECEIVED
No. 1564
From THE STEEL CO.
Date Apr. 25/24
Address Pittsburgh, Pa.
via Frt. Collect
QUANTITY | DESCRIPTION | CARLOAD
35,800 1¾" x 1¾" H. R.
B
THE FORGING CO.
Per Henry Day
Receiving Clerk
On our order No. 1354
2
3
FREIGHT BILL
Bill No.
Station
The Forging Co.
Way Bill No. 161718 Date 4/29/24
From
Car No. 789, 123
To:- Pennsylvania Railroad Company Dr.
For charges on the articles named below
Shipped By The Steel Co.
Original Point of Shipment Pittsburgh
Original Car
MARKS | ARTICLES | WEIGHT | RATE | FREIGHT CHARGES | ADVANCES | TOTAL
Steel Bars 35 800 15 53 50 53 50
C
Rec'd payment for the Company
Date 5/15/24 Wm Hamblin Agent
To - TONY CARLONE
Truckman
Newark, N.J.
The Forging Co.
30 Red Road
Newark
DATE | DESCRIPTION | AMOUNT
Apr. 2 Drayage - 2200 # Steel Bars 5 40
D
Charge to 1¾ x 1¾ H.R.
4
5
TABULATING SHEET
Hot Rolled 50¢ Steel
Receipts
1" x 1" | 1¼" x 1¼" | 1½" x 1½" | 1¾" x 1¾" | 2" x 2" | 2¼" x 2¼" | 2½" x 2½" | 2¾" x 2¾" | 3" x 3" | 3¼" x 3¼" | 3½" x 3½"
QTY. AMT. QTY. AMT. QTY. AMT. QTY. AMT. QTY. AMT. QTY. AMT. QTY. AMT. QTY. AMT. QTY. AMT. QTY. AMT. QTY. AMT.
1
2 Drayage 2,200 88.00
5.40
3
25 35,800 1,074.00
26
27
28
29 Freight 53.50
30
E
TOTAL 38,000 1,220.90
6
DEBITS
MATERIAL CONTROLLING ACCOUNT
MATERIAL | MATL UNIT | INVENTORY FIRST OF MONTH QTY. AMT. | PURCHASES DURING MONTH QTY. AMT. | TOTAL DEBITS QTY. AMT. UNIT PRICE
1" x 1" 50¢ lb
1¼" x 1¼" " lb
1½" x 1½" " lb
1¾" x 1¾" " lb 7,600 251.60 38,000 1,220.90 45,600 1,472.50 .03229
2" x 2" " lb
F
TOTAL

FIG. 5 THE DEBIT SIDE OF THE MATERIAL CONTROLLING ACCOUNT WITH THE VARIOUS DETAILS LEADING UP TO THE ENTRIES

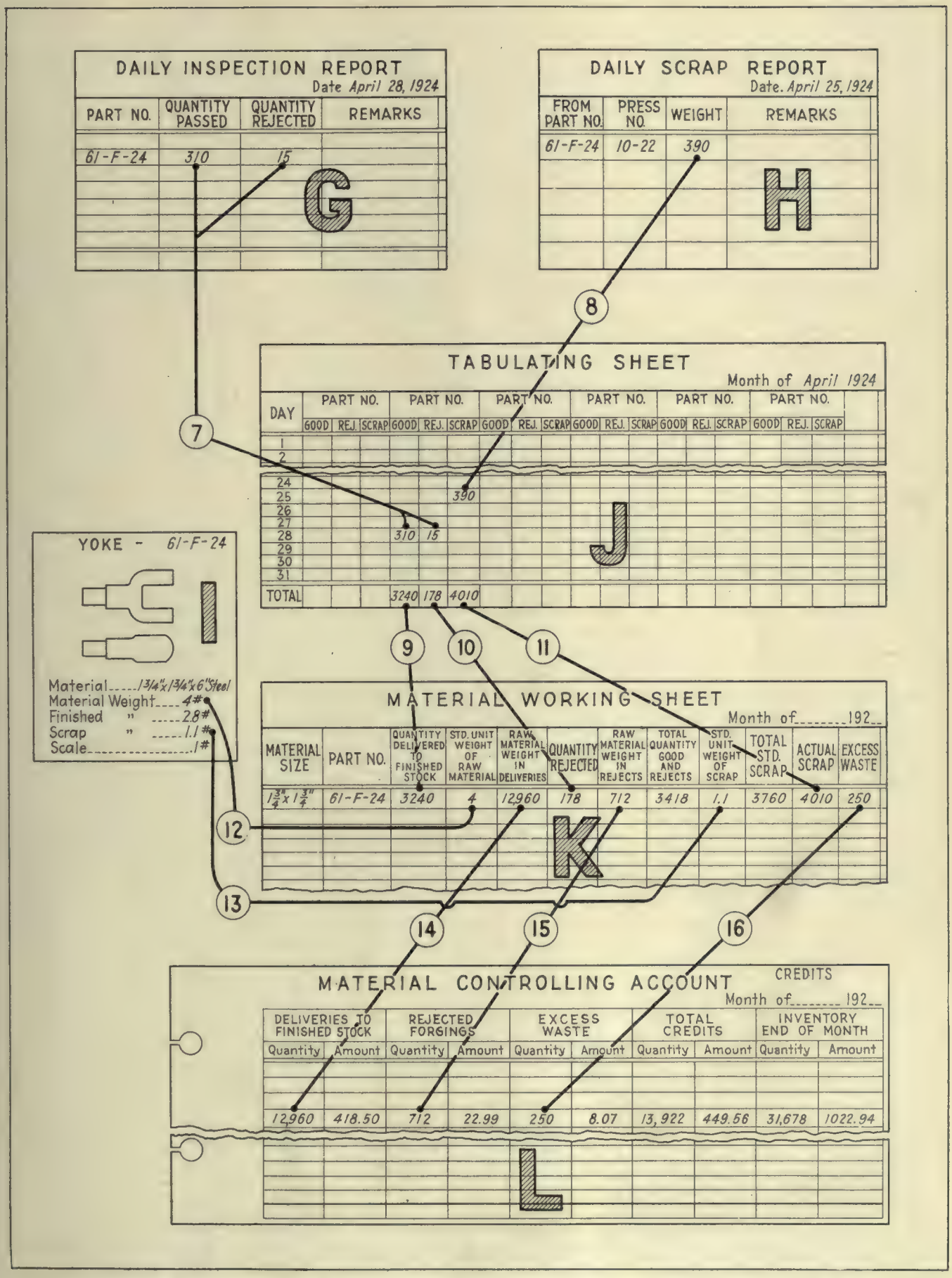

DAILY INSPECTION REPORT
Date April 28, 1924
PART NO. | QUANTITY PASSED | QUANTITY REJECTED | REMARKS
61-F-24 | 310 | 15
G
DAILY SCRAP REPORT
Date. April 25, 1924
FROM PART NO. | PRESS NO. | WEIGHT | REMARKS
61-F-24 | 10-22 | 390
H
8
TABULATING SHEET
Month of April 1924
DAY | PART NO. | PART NO. | PART NO. | PART NO. | PART NO. | PART NO.
GOOD | REJ. | SCRAP
1
2
24
25 390
26
27
28 310 15
29
30
31
TOTAL 3240 178 4010
J
7
YOKE - 61-F-24
Material 1 3/4" x 1 3/4" x 6" Steel
Material Weight 4#
Finished " 2.8#
Scrap " 1.1#
Scale 1#
9
10
11
MATERIAL WORKING SHEET
Month of 192
MATERIAL SIZE | PART NO. | QUANTITY DELIVERED TO FINISHED STOCK | STD. UNIT WEIGHT OF RAW MATERIAL | RAW MATERIAL WEIGHT IN DELIVERIES | QUANTITY REJECTED | RAW MATERIAL WEIGHT IN REJECTS | TOTAL QUANTITY GOOD AND REJECTS | STD. UNIT WEIGHT OF SCRAP | TOTAL STD. SCRAP | ACTUAL SCRAP | EXCESS WASTE
1 3/4" x 1 3/4" | 61-F-24 | 3240 | 4 | 12,960 | 178 | 712 | 3418 | 1.1 | 3760 | 4010 | 250
K
12
13
14
15
16
MATERIAL CONTROLLING ACCOUNT
CREDITS
Month of 192
DELIVERIES TO FINISHED STOCK | REJECTED FORGINGS | EXCESS WASTE | TOTAL CREDITS | INVENTORY END OF MONTH
Quantity | Amount
12,960 | 418.50 | 712 | 22.99 | 250 | 8.07 | 13,922 | 449.56 | 31,678 | 1022.94
L

FIG. 6 THE CREDIT SIDE OF THE MATERIAL CONTROLLING ACCOUNT WITH THE FORMS WHICH LEAD UP TO IT

also be considered as a cost of material, and consequently the drayage bill, Form D, when approved and identified, is entered on the tabulating sheet in the same manner as the freight charges. This entry is shown by line 5 which, of course, covers the local purchase of a ton of steel previously recorded.

Totaling at the Close of the Month

At the close of the month, by totaling the columns on the tabulating sheet we obtain the total quantity of each kind of steel received during the month and also the total cost of each kind of steel. These totals are then posted to the Material Controlling account, Form F, as indicated by line 6.

The purchases for the month which have just been entered on the Material Controlling account are now added to the inventory figures representing the quantity and value of material on hand at the first of the month, and the figures in the Total column, which represent the total quantity and value of raw materials, are obtained. By division we arrive at a true average unit cost of each raw material. This unit cost is to be used in pricing the credits to the Material Controlling account.

Fig. 6 illustrates the credit side of the Material Controlling account with the forms which lead up to it. In this diagram the inspection report is used instead of the billings, but we fully adhere to the principle enunciated in the fourth paragraph of this article: "The fact that such an article has passed inspection automatically accounts for this definite amount of material." By so doing, the great bulk of the material is accurately accounted for and a great amount of detail, with its attendant danger of mistakes and omissions, is eliminated. The daily inspection report, Form G, is therefore the basis of our material credits. In the illustration the quantities of good and rejected forgings reported by the inspector are entered daily on the tabulating sheet, Form J, as indicated by line 7. To complete the account, the quantity of scrap made on each part as reported on the daily scrap report, Form H, is also entered on this tabulating sheet, as shown by line 8. By so doing a complete up-to-date record is maintained. so that at the end of the month the material account can be promptly closed. Ordinarily it is not necessary to keep the scrap from each part separate. It is done here to make the example clear. For this closing the totals from the tabulating sheet are assembled on the material working sheet, Form K, by material classes or sizes.

Calculating the Weights of Materials

In the illustration it was assumed for the sake of clearness that part No. 61-F-24 was the only one using 1¾ by 1¾ in. steel and the entries of "good," "rejects" and "scrap" are indicated by lines 9, 10 and 11. The standard unit weight of raw material is obtained from the specification as indicated by line 12 and, similarly, the standard unit weight of scrap, as indicated by line 13. Extending the good forgings at the standard unit weight gives 12,960 lb. of raw material represented by the good forgings made. Similarly, by extending the rejected forgings it is found that 712 lb. of raw material are represented by the rejected forgings. Now, to supply the missing link we must determine whether or not there has been an excess amount of waste. The total quantity of good and rejected forgings is 3418, and this figure extended at the standard unit weight for scrap shows a standard and inevitable scrap of 3760 lb. The actual scrap has been 4010 lb. so that there is an excess of 250 lb. of steel in the scrap which must also be a credit to the Material Controlling account. It should be mentioned that this is a most valuable and important figure to place in the hands of the management for the control of preventable waste.

The entries on the credit side of the Material Controlling account are made directly from this working sheet, as indicated by lines 14, 15 and 16. These credits are each extended at the unit price shown on the debit side of the account, so as to show the true value of material in good forgings, rejected forgings, and excess waste. These figures are added to give the total credits, and finally the total credits are subtracted from the total figures on the debit side to give the quantity and value of the inventory at the end of the month.

The objection may be raised that this method will not give a division of material between raw material, material in process, etc. But there is little need for a division of values in this way; the amount of work involved in keeping the records as outlined is reduced, and the inventories kept in accordance with these principles have been found to be reliable. In any event it is pertinent to inquire why all the cumbersome detail that is ordinarily used can be tolerated when a few simple forms will give better control and disclose preventable waste, wherein an added profit lies.

Management and Standardization

SINCE its organization in 1918 the American Engineering Standards Committee has served as a national clearing house for engineering and industrial standardization ideas and projects. Its purpose has been to co-ordinate standardization work in individual industries, and eventually develop a unified system of national standardization. The recent appointment of a committee to act as an advisory body to the American Engineering Standards Committee marks definite recognition of the fact that standardization has now become a managerial problem of the first rank.

The advisory committee consists of the following: J. A. Farrell, president of the U. S. Steel Corporation; G. B. Cortelyou, president of the Consolidated Gas Company, New York; J. W. Lieb, vice-president of the New York Edison Company; L. F. Loree, president of the Delaware and Hudson Company; and Gerard Swope, president of the General Electric Company.

This committee will assist in keeping executives in touch with the national movement, in extending its influence among industrial groups, and in bringing about co-operation between industry and government in standardization work, and particularly in the solution of the problem of industrial waste.

Better Shipping Containers

Materials of Construction, Their Uses and Advantages

By FLOYD T. SMITH

Industrial Department, General Electric Company

THE several forms of containers may be grouped into sections descriptive of the material of which they are constructed, as follows: Wood; metal; fiberboard and paper; burlap, bagging and sacking; and glass and earthenware.

One type of wooden container used in large quantities is made of veneer or other light materials, the four sides strapped with wire and the ends cleated. This form of container is used in shipping a very wide

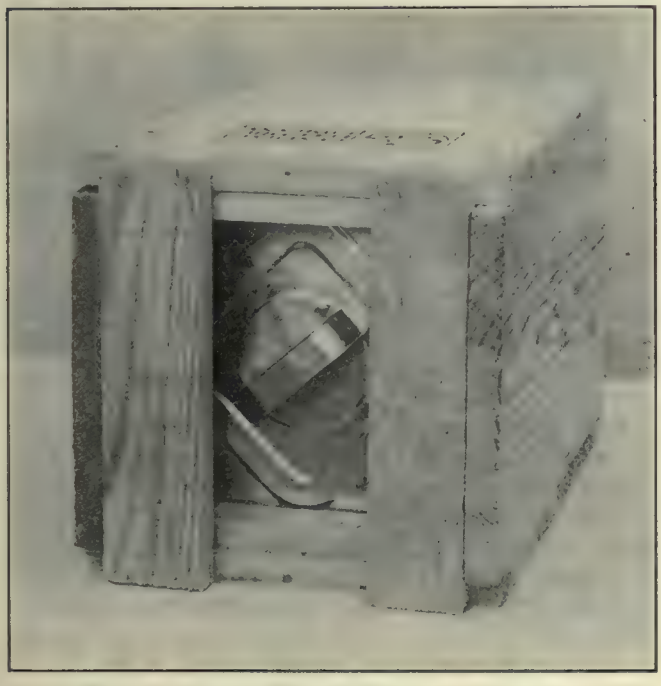


FIG. 1 PACKING OIL FOR DOMESTIC SHIPMENT

variety of commodities. The general construction of these wire-bound boxes is one thickness of veneer. There are also in common use containers made of two or more thicknesses of veneer glued together with the grains of the wood running in opposite directions. This veneer container is used largely for textiles. Some of the advantages claimed for the veneer container are savings in transportation charge, cost of the container, storage space, and cost of assembly and packing.

Barrels, being less susceptible to damage from jars in falling than rectangular containers, are frequently used for shipping light and fragile material.

The making of barrels and kegs is known as cooperage. There are two kinds of cooperage, commonly distinguished as tight and slack. Tight barrels are intended for liquids; slack barrels, for dry articles. The barrel that carries alcoholic liquids is considered the highest class of tight cooperage, while the vegetable barrel is typical of slack cooperage.

In slack cooperage, woods of softer grades are used, such as red gum, pine, beach, elm, maple, chestnut, birch, basswood, spruce, ash, oak, cottonwood, tamarack, cypress, sycamore, hemlock, cedar, yellow poplar, balsam, Douglas fir and willow.

Some woods are waterproof, others are not. Woods with large pores generally are not suitable for tight cooperage although, by treating, the pores may be closed. White oak is generally conceded to be the best for tight cooperage. The pores of red oak are not closed; therefore, this wood is not suitable for tight cooperage.

Barrels used for oil are usually coated on the inside to make them tight. The first coat is usually some sugar house by-product, water-glass or vegetable gum, that prepares the wood for a second coat, such as a high-grade hide glue. This has resilience and elasticity and is unattacked by the oil.

All cooperage utilizes three elements, the staves, the heading, and the hoops. Sometimes on slack cooperage an extra small hoop is used to fasten and hold the head in place.

In woods for hoops, toughness and strength are essential qualities—the hoops must bend without breaking. Two styles of wooden hoop are in use, coiled and straight. The coiled hoop is manufactured from elm, birch and hickory. Straight hoops are made from saplings called hoop poles, split longitudinally, each being large enough for two hoops. Many wooden barrels, however, are furnished with metal hoops.

For heading wood a white wood that presents a good appearance is desirable. It must be tough and strong enough to carry the load and free from odor or tastes that might injure the contents. Red gum has been found to be satisfactory and is desirable because of the abundant supply. Scrub pine is used for nail kegs and for containers for small hardware.

Shippers of meat, butter, lard and food products must select the most suitable woods for their barrels. Custom and locality have much to do with the selection, but it is easy to understand that a pine barrel might taint food with a taste of turpentine. One of the heaviest demands for barrels was formerly from the cement manufacturer. Barrels are used as containers

FIG. 2 COMPARISON OF BULGE TYPE AND STANDARD OIL BARRELS

in large numbers for flour, sugar, salt, molasses, oil, lard, pork, dry paint, glue, snuff, oatmeal, screws, castings and general hardware.

There is no well-defined line of demarcation which separates some forms of the barrel from the hamper or stave basket. Baskets and hampers in many forms and shapes of splint or stave are constructed of the following material: Bamboo, grass, rattan, reed, straw, twisted paper, fiber, willow wood or other vegetable or wood fiber.

Metal Containers

Many forms and sizes of barrels, boxes, pails, kegs, and cans are made of metal. Metal barrels or drums

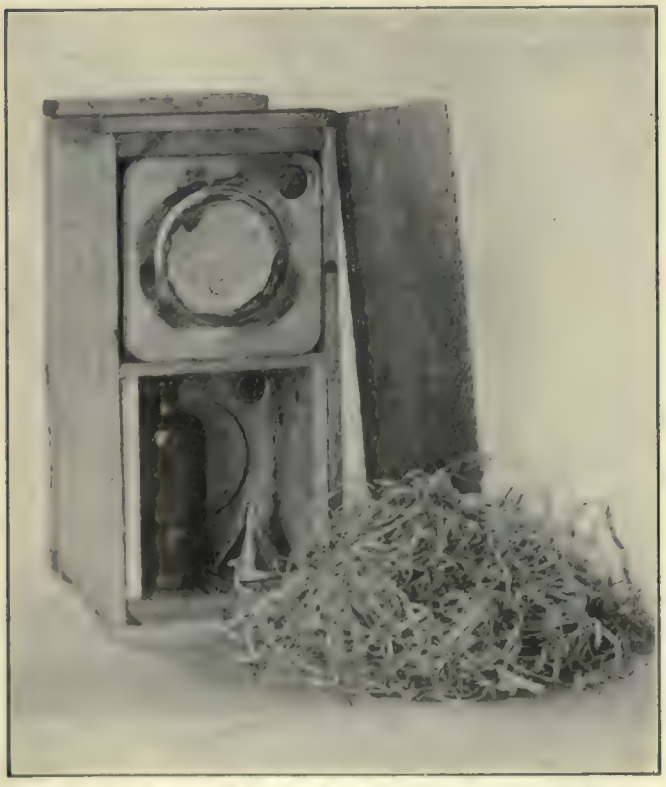


FIG. 3 SHIPPING CONTAINER FOR ELECTROLYTE AND OIL

are made of annealed sheets to stand hard service and for use as a "one way container." Steel, when used for general purpose containers, has limitations. It is high in price and is not always easy to obtain, and there are only a few liquids which can safely be put in steel containers. If the liquid contains acid or is affected by chemical reaction set up in the steel, steel containers are undesirable. No steel containers resist liquids which have corrosive or oxidizing tendencies. Food products, even in dry form, cannot be shipped if the contents are injuriously affected by the container.

Steel boxes are manufactured in any desired size, can be furnished with protected hinges, and can be knocked down to a very small percentage of the assembled size. This type of container can be used many

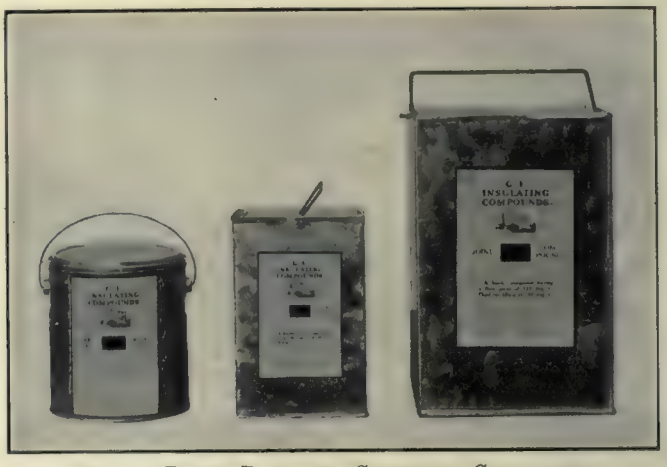


FIG. 4 PAINT PAIL AND COMPOUND CANS WITH STANDARD LABELS

times and can be nested when returned. Its first cost is more than that of wood but it occupies about 15 per cent less space than the wood container in carrying the same contents.

Iron barrels are made from no. 16 to 19 gage iron in capacities from 5 to 110 gal., and are coming more and more into use. The lighter weight drums and barrels are sold outright, the heavier ones on a return basis. Thirty round trips is not too much to expect of a good drum.

A bulge is used in a few forms, but most drums are cylindrical in form. The bulge type can be rolled more readily on a runway. The cylindrical form, if the hoops are well made, will not dent so easily and will stand abuse better. The advantage of iron over wood is that it can be made oil- and naptha-tight. The chief disadvantage is that the oxide will flake and fall off inside. This contaminates liquid, particularly if a rusty barrel is used.

The manufacture of tin cans is one of the country's large and important industries. The sizes in common use are half-pints, pints, quarts and gallons. The tin can is made in countless shapes and sizes for such products as talcum powder, paint, axle grease, varnish, compound, paste, shellac, and gasoline. Tin cans replace many wooden containers previously used. Many designs of wooden paint pails and kegs are now replaced by metal. The 5-gal. can for petroleum is considered standard by many refineries. This container is con-

sidered particularly desirable for shipments to many foreign countries by reason of its salvage value. It can be used for carrying water and other liquids, and for other household uses, and is sometimes split and used for house covering. In such containers, fuel oils and naptha are shipped to all parts of the world, and smaller sizes are used for oil, grease and soft soaps.

Fiberboard, Cellular and Paper

A fiberboard container is light in weight, strong and tough. It is assembled by the use of paper tape, cloth or metal stitching. The metal stitching may be applied by hand or machine. In shipping many products, this type has proved an admirable container, providing proper protection for the contents and, being light in weight, minimizing the cost of transportation.

Corrugated containers have come into general use as a cheap and effective substitute for wood boxes. A tough jute board is used for the outer plies or liners. The corrugations are made of straw or chip board, are about $\frac{3}{16}$ in. in height and about 5 to the inch. The corrugations are formed by passing the straw or chip board between corrugated rollers which crimp it into the desired shape. It may be single wall or double

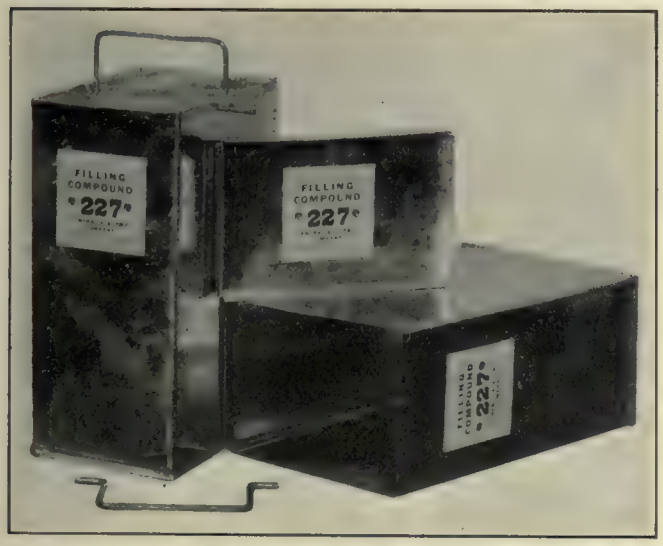


FIG. 5 STANDARD CONTAINERS FOR INSULATING COMPOUND

wall or double, double wall. The corrugations give increased strength, and the facings give rigidity and prevent the corrugations from stretching and flattening. The walls are the flat sheets inserted between each line of corrugations. They are made of material of various strengths regulated by the Interstate Commerce Rulings for the weight which the container is required to carry. They may be so treated as to make them water- and moisture-proof.

The fiberboard and cellular containers are made for all manner of commodities to almost any size required, up to a weight of 90 lb., and an outside dimension not to exceed 90 cu. in. They may be provided with a wooden frame which would increase the permissible weight, carrying up to 200 lb. (Official Express Classification No. 29 and I. C. C. No. 2180.) Building

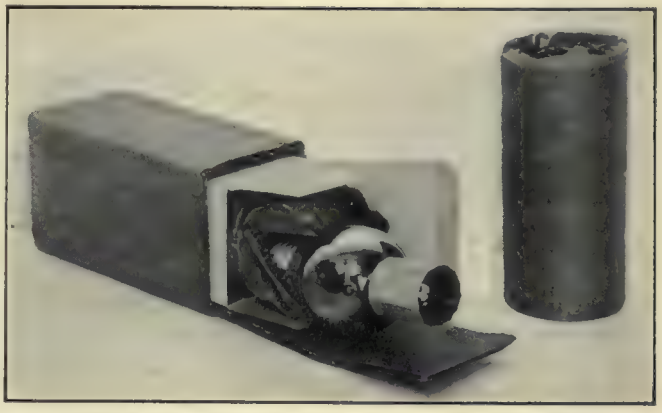


FIG. 6 SHIPPING CONTAINER FOR TUNGAR BULBS

boxes to the required dimensions eliminates extra work and expense in packing, prevents the contents from shifting about in transit, and facilitates counting, because the packer knows that a 1-gross box will contain exactly one gross and no more.

The fiber and cellular containers are made in many forms, the single-piece box; the two-piece box (the telescope box with inner and outer sections of equal length); the two-piece box (other than telescope box); the three-piece box; and the triple slide box. Often, for convenience, the fiber and cellular containers are made with a removable top. The fact that a large quantity of merchandise is shipped in rectangular containers seems to have been settled by custom. Gradually a change has been made and many articles previously shipped in small sacks are now shipped in cartons.

The average fiber and cellular box weighs only from 2 to 3 lb., which means a reduction of shipping weight anywhere from 10 to 50 per cent when compared with the same size in a wooden box. It is shipped flat when empty and, in this form, occupies about one-tenth the space it would occupy when set up.

One of the attractive features of the fiberboard or cellular container is the use of this material for internal

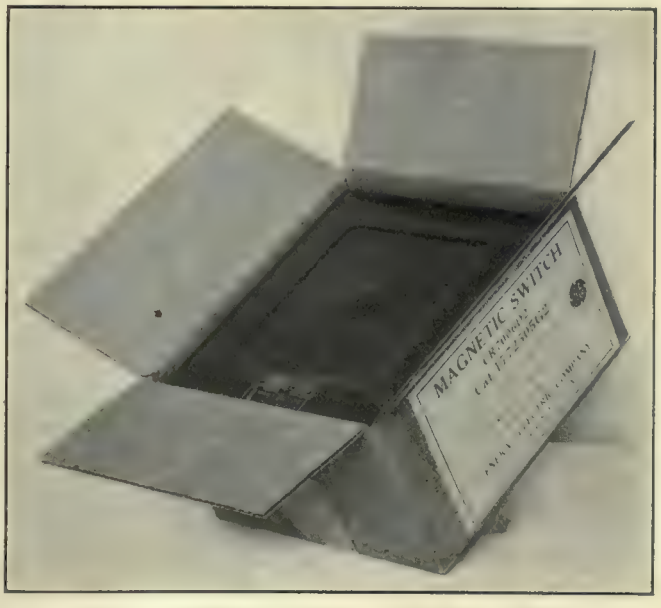


FIG. 7 DOMESTIC PACKING. MAGNETIC SWITCH

bracing, when used as a container for small apparatus, machines and other commodities requiring such bracing. This material used for internal packing is much more efficient than either wood or excelsior, and much more convenient in use and cheaper in price.

In the shipping room where fiber and cellular containers have been adopted, nailing is not required, there is less noise and litter, and no splinters or deflected nails injure the contents and employees.

One disadvantage resulting from the use of fiber and cellular containers lies in the fact that, while forms and sizes are manufactured and are adaptable to one or more applications, they cannot readily be changed in size and shape. On the other hand, the wooden container can be built to fit each use and can be changed in shape and size if necessary. The fiber and cellular containers are limited as to strength and have not the strength to resist pressures as has wood. Disintegration and deterioration from dampness and moisture are other objectionable features. A similar condition of depreciation of quality is brought about by too dry storage which, through oxidation, causes loss of fiber strength and makes the material very brittle.

Burlap is woven from jute fiber. The best grade of jute is raised in India, where fiber is extracted by soaking the jute in stagnant water and then covering with jungle plants or clods of earth. When this procedure is completed, the workmen separate the bark from the wood by thrashing with sticks. The water is then wrung out by hand and the fiber hung on lines to dry. The product is baled and, in this condition, large quantities are shipped from Calcutta, principally to Scotland and the United States for weaving into burlap

FIG. 8. RADIOLA LOUD SPEAKER, SHOWING HORN AND SPEAKER PACKED IN SEPARATE COMPARTMENTS OF FIBERBOARD CONTAINER

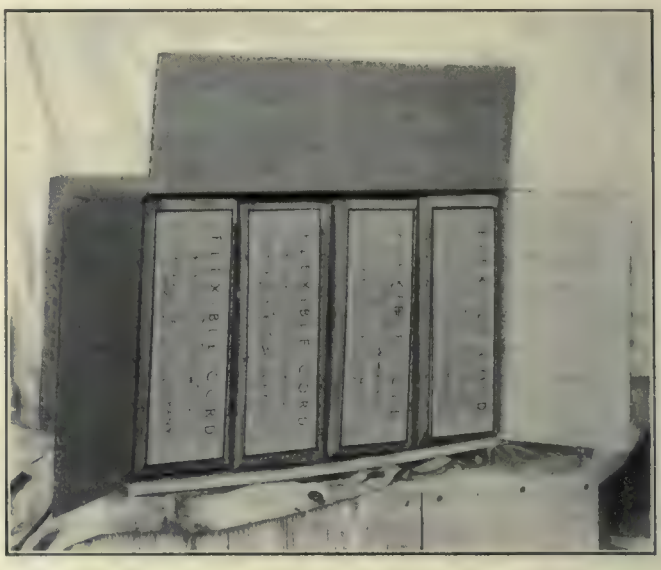


FIG. 9 DOMESTIC PACKING, SHOWING FOUR BOXES IN FIBERBOARD OUTER CONTAINER

for packing purposes. This type of container requires less space, may be returned and used several times, and is available at a minimum transportation cost.

Bagging is the name given to the textile used for making bags. This material was originally Baltic hemp, but modern requirements call for so many different types of bagging that it is not surprising to find all kinds of fibers used for this purpose. Most bagging is now made from the yarns of the jute fiber. The particular type of bagging depends naturally upon the kind of material it is intended to carry. The coarsest type is that known as cotton bagging, which derives its name from the fact that it is used for wrapping raw cotton. A similar but rather finer make is used for Sea Island and other finer cotton and for grain, spices, flour, and coffee. For transporting such substances as sugar it is not uncommon to line the bag with paper or fabric, thus excluding foreign matter and minimizing losses. Although there are large quantities of seamless bags woven in the loom, the greater part of cloth is woven in the ordinary way. It is then cut up into the required sizes by hand or by machines, and afterward sewn by one of the chain-stitch or straight-stitch bag-sewing machines.

Sacking is a heavy, closely woven fabric, originally made of flax but now made of jute or hemp. The more expensive kinds are made of hemp.

Glass and *earthenware* containers are very limited in their use. They are very expensive to manufacture when compared to other forms of containers, and must necessarily be handled with care to prevent breakage.

Containers made of glass, stone ware and silica ware are used in chemical plants. Glass bottles of all sizes and shapes are used as containers of medicines, extracts, oils and the various kinds of liquids.

Allocating Power Costs to Product

Brings About Economies in Steam Generation and Use

By WALTER N. POLAKOV

Consulting Engineer

THE correct allocation of power costs to product is important, particularly in those branches of industry where power, or steam for processing, forms a large percentage of manufacturing expense.[1] A study made for the purpose of determining proper apportionment, in addition, usually brings about economies in the generation and use of steam.

During one month the total power plant expense at the Mount Hope Finishing Company was $22,164.47, and 43,577,000 lb. of steam was generated by the boilers.[2] Of this amount 14,860,000 lb. passed through the engines, exhausted at 7-lb. pressure, and was consumed in processes of manufacture. The company was advised to determine the prices of live steam, electricity and exhaust steam as follows. Since 66 per cent of the total steam was used as live steam, $22,164.47 × 0.66 = $14,728.68, was charged to live steam, making its unit cost about $0.51 per 1000 lb.

Considering the engine room alone, the loss of heat in the steam passing through engines was roughly:

$$\frac{1191.6 \text{ B.t.u.} - 1157.1 \text{ B.t.u.}}{1191.6 \text{ B.t.u.}} = \text{about 3 per cent}$$

Therefore, only about 3 per cent of fuel was charged to electricity, while labor and fixed charges were determined directly as actually incurred. Thus:

Fixed charges	$2,578.40
Labor	1,076.73
Fuel	445.62
Total charge to electricity	$4,100.75

On a total output of 366,984 kw-hr. this charge reduces to a very low unit cost of $0.0112 per kw-hr. The calculation makes the efficiency of the engines appear unreasonably high, but the value of the exhaust needed for processing fully warrants such distribution.

The cost of exhaust steam is the difference:

Total power plant expense		$22,165.47
Cost of live steam	$14,728.68	
Cost of electricity	4,100.75	
		18,829.43
Charge against exhaust		$3,336.04

This makes the unit cost on 14,860,000 lb. output of exhaust only $0.22 per 1000 lb.

Such a method stimulates the use of low-priced exhaust which otherwise would (as it has in the past) go to waste. Second, it demonstrates that electricity is a by-product of reducing steam pressure and cannot be purchased at a similar price from outside, and third, it is fundamentally correct, since every cent expended is accounted for. If all steam is to be generated and some reduced to lower pressure without the use of engines and generators, the total expense would be:

Total power plant expense	$22,164.47
Less engine room labor[3]	1,076.73
Net expense	$21,087.74

Therefore, the cost of 1000 lb. of steam would be $0.483. But, in addition, electricity has to be purchased at about $0.04 per kw-hr. which will add about $11,000 to the total power plant expense, making the final total expense $32,087.74, or causing an annual loss of nearly $120,000.

The check on forms of power thus priced is obvious:

Item	Amount Lb. or Kw-Hr.	Unit Price Per 1000 Lb. or Kw-Hr.	Total Cost
Live steam	28,717,000	$0.51	$14,728.68
Exhaust steam	14,860,000	0.22	3,336.04
Electric current	366,984,000	0.0112	4,100.75
Total			$22,164.47

When the quantities of power used by different departments or processes are known, and prices are determined, the practice of distributing power costs to departments is relatively simple. If this is correctly done, the same ratios can be used for apportioning power costs to product.

[1] See MANAGEMENT AND ADMINISTRATION, May 1925, pp. 433-436, "Avoiding Incorrect Power Cost Distribution," by Walter N. Polakov.

[2] An example from the practice of Walter N. Polakov and Company. See "Transactions of the American Society of Mechanical Engineers," v. 45, 1923, pp. 405-414, "A Steam-Loss Prevention Plan Operating in a Textile-Finishing Plant," by Henry M. Burke, Plant Engineer, Mount Hope Finishing Company.

[3] Fixed charges on engine room will remain, as the old engines will have to be kept until amortized or sold, or kept for protection; loss of 3 per cent of the fuel value will be the same with the use of reducing valves.

TABLE 1. DISTRIBUTION OF POWER PLANT EXPENSE MAKING UP THE TOTAL MONTHLY CHARGE

Distribution of Dept. No. 16 expense, four weeks ending August, 1923

DEPT.	LIGHTING	TRACTOR CHARGE	POWER AND STEAM	TOTAL
0	$26.62	$9.26	$12.40	$48.28
1A	17.12	.....	24.90	42.02
B	0.48	.....	8.10	8.58
2	2.59	.....	86.30	88.89
3	5.85	11.04	2710.14	2727.03
4	4.64	.....	1684.30	1688.94
5A	5.47	.....	280.26	285.73
6A	1.69	27.40	1458.10	1487.19
7A	13.31	.....	490.12	503.43
B	1.66	.....	.....	1.66
C	8.28	10.04	1050.68	1069.00
D	.....	.....	110.40	110.40
E	8.28	13.02	291.20	312.50
8	1.18	9.20	636.12	646.50
9A	7.81	.....	536.40	544.21
E	1.69	.....	.....	1.69
10	14.28	18.21	2840.18	2872.67
11	17.41	21.60	996.28	1035.29
A	4.00	.....	526.01	530.01
12A	12.13	13.60	5177.45	5203.18
B	8.10	.....	721.60	729.70
C	11.02	12.62	1581.10	1604.74
13A	9.13	6.90	9.02	25.05
B	7.58	.....	14.21	21.79
C	3.81	.....	9.50	13.31
D	3.20	.....	17.24	20.44
E	5.08	6.90	5.10	17.08
F	7.13	6.90	11.20	25.23
G	1.50	6.90	9.10	17.50
14A	25.69	22.80	25.40	73.89
D	3.35	.....	.....	3.35
15	3.21	.....	10.20	13.41
17	3.00	6.72	81.60	91.32
18	1.44	.....	13.20	14.64
19	1.70	.....	6.00	7.70
20	11.81	0.94	2.84	15.59
21A	27.42	9.10	12.10	48.62
B	18.00	16.40	9.10	43.50
22B	3.88	13.80	8.41	26.09
C	2.84	.....	3.40	6.24
H	2.00	.....	74.86	76.86
Perox. Bldg.	1.20	.....	40.20	41.40
Garage	1.42	.....	16.40	17.82
Rest	2.00	.....	.....	2.00
Total	$320.00	$243.35	$21,601.12	$22,164.47

Fig. 1 represents a power expense allocation, on a single page, distributing power cost to different tenants getting different services from a power plant. The section at the top applies to the boiler house, which furnishes steam directly to the refrigerating department and to the electric plant. The cost of steam appearing in the section "Power" is allocated to the three sub-divisions, proportions being determined by meters. The refrigeration department, besides all its own expenses, bears a pro-rata of business expenses, administration, supervision, labor, ammonia and other supplies, repairs, cooling, water for ice, etc. Similarly, all expenses connected with the generation of electricity are added to the cost of steam used for this purpose, but the value of the condensed water, used for ice making, is credited to electricity and charged against the ice plant. Steam and electricity charges are further distributed to the tenants, as shown.

Where power costs are distributed among departments of the same concern instead of among different tenants, the procedure is substantially the same. (See Fig. 2.) In a case where the total power cost has to be distributed among 44 manufacturing departments the weekly "steam dockets," as shown on Fig. 3, are totaled for the month, or any other period, by departments and finally submitted to the accounting department in a form similar to Table 1. It will be seen that the total thus distributed is equal to the total power plant expenses which, in the example cited, were:

Labor	$2,153.47	
Fuel oil	14,854.20	
Operation		$17,007.67
Maintenance		820.53
Manufacturing expenses		150.15
Fixed charges		4,186.12
Total power production		$22,164.47

When these power costs are apportioned to different grades or kinds of products, it is easy to see how inaccurate the pricing of goods may be by using mere averages.

Let us say that 6,443,134 yd. of material were finished during the month. Then the *average* power charge per yd. will be $0.00344. If four different finishes were made during the month, involving different methods of treatment, then the output of each class and departmental power charge can be tabulated as follows:

CLASS	OUTPUT YD.	DEPARTMENTS' CHARGE	UNIT COST PER YD.
A	3,200,104	$11,785.35	$0.00368
B	1,552,200	6,711.76	0.00432
C	1,025,800	2,653.11	0.00258
D	665,030	1,014.25	0.00153
Totals	6,443,134	$22,164.47	Average per yd: $0.00344

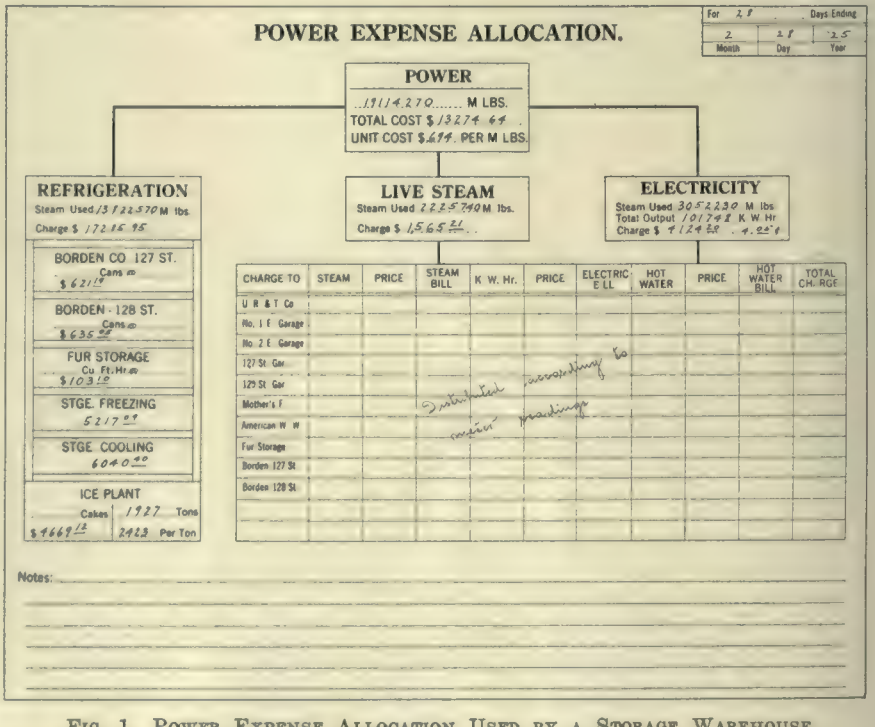


FIG. 1 POWER EXPENSE ALLOCATION USED BY A STORAGE WAREHOUSE

Increment of power to total cost is considerably different for each class of goods. Therefore, if the average is assumed to be true for classes B and C, and sales efforts are made to double the output of class B. there would be over $2700 loss, the cause of which would remain undetected unless proper apportionment of power costs were made.

While proper costing of power and correct distribution of expense to product are in themselves important, closer supervision over distribution and use of power also leads to the discovery and stoppage of very considerable losses. In 1923, the evidence on record at the Mount Hope Finishing Company plant showed

UNIT COSTS
Power Plant Operation

Month of.....19.....

Power Delivered \ Plants		East Side				West Side				Pumping Plant				All Plants		
		Number of B Hp Hr Equal 1 Unit	Monthly Total Power Delv'd	Monthly Total Cost	Cost Per Unit	Number of B Hp Hr Equal 1 Unit	Monthly Total Power Delv'd	Monthly Total Cost	Cost Per Unit	Number of B Hp Hr Equal 1 Unit	Monthly Total Power Delv'd	Monthly Total Cost	Cost Per Unit	Monthly Total Power Delv.	Monthly Total Cost	Average Cost per Unit
Live Steam Unit: B.Hp.Hr.	B.Hp.Hr.															
Electric Power Unit: K.W.Hr.	Generated K.W Hr															
	Generated B.Hp Hr.															
	Purchased K.W Hr															
	Total															
Electric Light Unit: K.W.Hr.	Generated K.W Hr															
	Generated B.Hp Hr															
	Purchased K.W Hr															
	Total															
Compressed Air Unit: Cu. Ft. Free Air per Min at 100 lbs. per Sq. Inch	Cu. Ft. Free Air Per Min at 100° F.															
	B. Hp. Hr.															
Hydraulic Power Unit: 1 Gal. per Minute at 100 lbs. per Sq. Inch	Gals Per Minute at 100° F.															
	B. Hp. Hr.															
Total Power Delivered to Works	B. Hp. Hr.															
Total Power Generated in Plant, Based on Coal Burned Unit: Tons Coal Burned per Month																

FIG. 2 POWER EXPENSE ALLOCATION USED BY AMERICAN LOCOMOTIVE CO., 1908

that the following total yearly savings had been made:[4]

In generation	$39,760
In distribution	12,320
In utilization	24,800
Total	$76,880

which represented over 20 per cent of the total power expense.

Even in the first half year the effects became evident:

	Preceding Half Year	*Following Half Year*	*Saving*
Steam used per yd., lb.	5.23	4.95	5.4%
Cost of steam per yd.	$0.00286	$0.00235	17.8%

This economy was brought about by the following steps:

1. Measuring input and output.
2. Recording all pertinent data.
3. Interpreting their meaning.
4. Stimulating interest in betterment.
5. Training men and educating foremen.
6. Supervising all details.

[4] See footnote 2, page 553.

For the latter purpose the office of power dispatcher was created and the man in charge, beside keeping all records and accounts, constantly supervises and directs distribution and the uses of all forms of power. While his salary is an expense, he saves it many times over by the results he brings about.

Meters located in the dispatcher's office[5] draw continuous records, and by watching these records and analyzing them, the dispatcher aims:

1. To maintain uniform load on the power plant by distributing and smoothing out peaks, thus increasing load factor.
2. When peaks or valleys cannot be avoided by means of scheduling factory processes, to reasonably foretell them and inform the operating engineer to adjust conditions accordingly.
3. Continually to observe the steam and power demand of each and every department and distinguish between legitimate use (proportionate to work carried) and waste. Telephone communications with foremen and personal inspections lead to stoppage of leaks or misuses thus discovered.

In this manner, one of our clients reported, for instance, the following uneconomical practices detected and discontinued:

1. Use of exhaust steam instead of high pressure in caustic evaporators. Actual annual saving, brought about as a result, was $3800.
2. Heating water for silk dye department in two large storage heaters instead of blowing steam into tubs. Annual saving, $20,000.
3. Change of method of heating dolly washers resulted in a saving of $3200 annually.

STEAM COST DOCKET

Section

FOREMAN: Mr. L. Crosby
DEPARTMENT: WHITE CANS
6-a.

Date Month	Date Day	Pounds of Steam	Cost Per M	Total Cost	Remarks
Aug.	6	110,240	.35	$ 38 59	Beginning August 1st. only EXHAUST STEAM used.
	7	106,180	.35	37 16	
	8	112,264	.35	39 19	
	9	109,154	.35	38 21	
	10	100,124	.35	35 04	
	11	108,844	.35	38 08	
		646,836		$226 28	

FIG. 3 STEAM DOCKET SENT TO DEPARTMENT HEADS

[5] See MANAGEMENT AND ADMINISTRATION, May 1925, Fig. 3, p. 434.

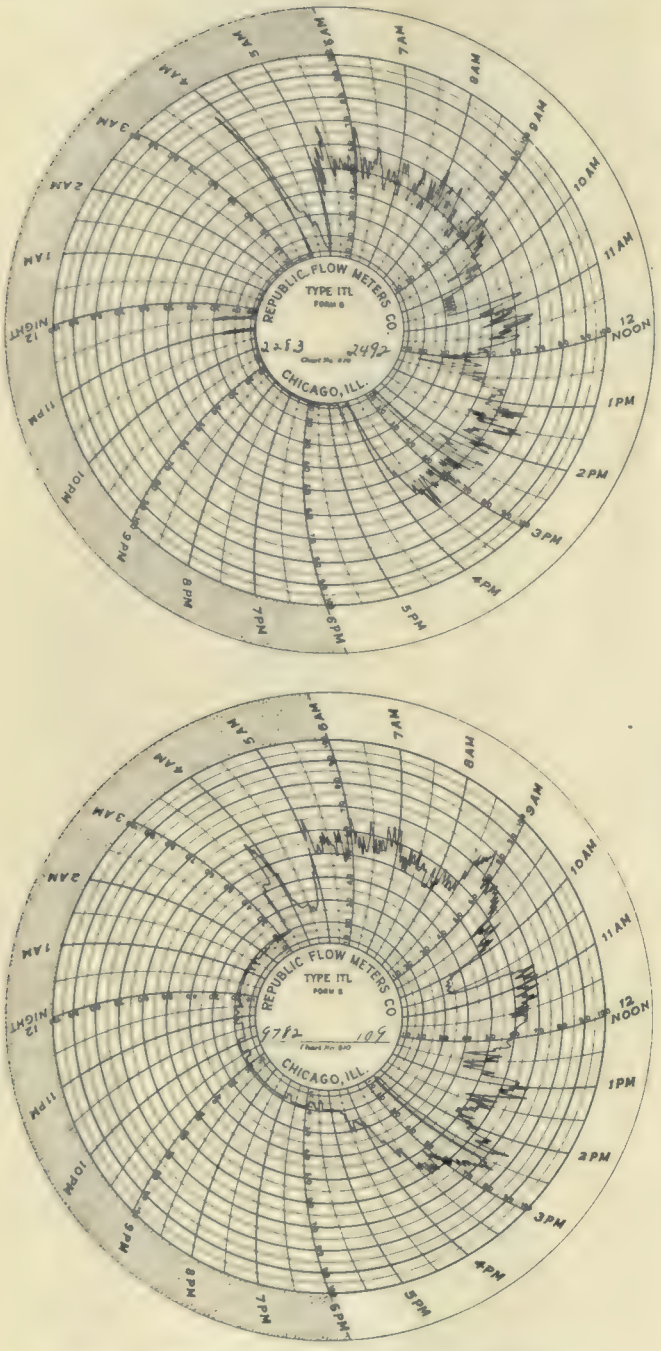


FIG. 4 STEAM DEMAND UNDER ERRATIC PRODUCTION

4. Modification of heating methods in washers produced economies equivalent to an annual saving of $5400.

Chart records of different processes using steam or power, as shown in Figs. 4 and 5, are of the utmost importance to the plant engineer in carrying out the work as planned, controlling the progress of developments, and maintaining the interest of the men responsible for performance.[6] But the usefulness of such information does not stop here. From time to time information brings to light some additional economies, such as cutting down idle time and thereby decreasing the expense burden that comes from wasting steam and power to keep a machine in readiness during the idle period.

Results that follow a study of power in any plant are well worth securing. Apportioning power cost to product leads to a number of major improvements and is conducive to substantial savings, without involving capital outlay except for a few meters. Work of such a nature establishes intimate contact between accounting office and power plant, between dispatcher's office and manufacturing departments, between engineering office, general management and sales department. It brings about co-operation, friendly competition in striving for perfection, greater good will and higher economy in all branches of plant operation.

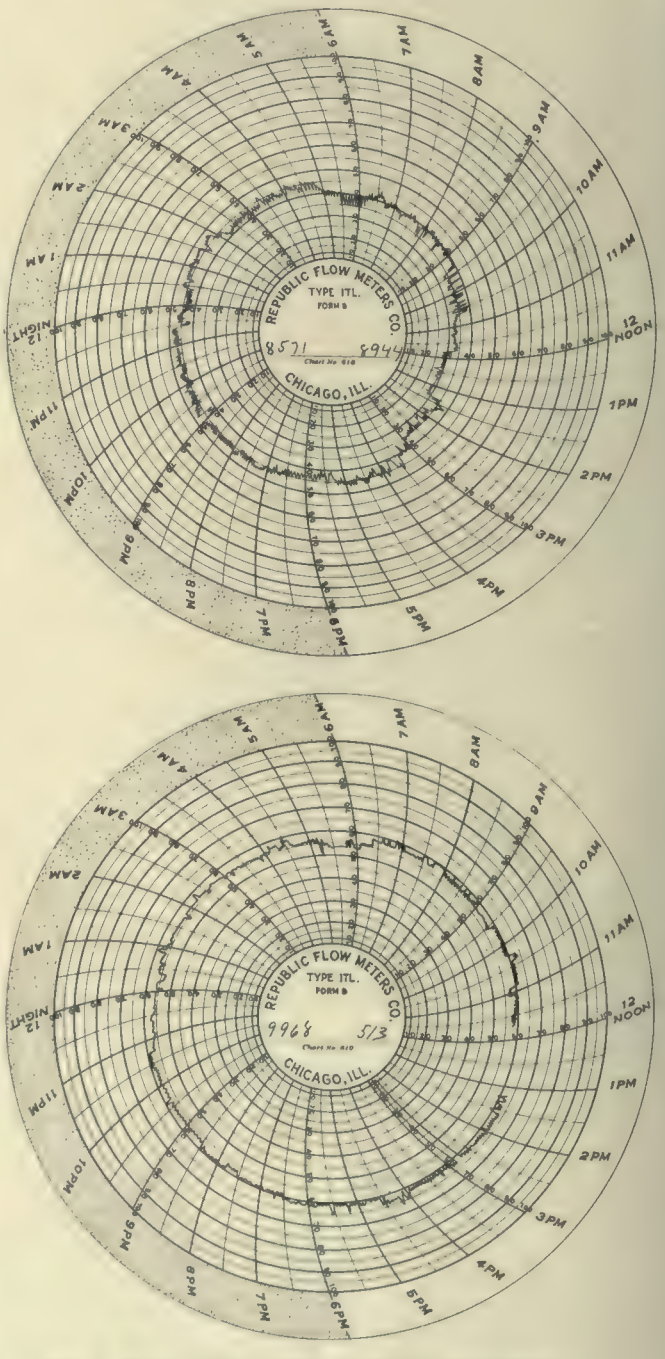


FIG. 5 STEAM USED UNDER UNIFORM PRODUCTION

[6] See MANAGEMENT AND ADMINISTRATION, Feb. 1925, pp. 125-127, "72% Efficiency and Good Will," by H. Brunner.

$15,000,000 Salvaged by Ford Plants

Waste Reclamation Methods Net This Vast Sum Annually

By GEORGE E. HAGEMANN

Associate Editor, MANAGEMENT AND ADMINISTRATION

THE by-products business of the Ford Motor Company during 1924 totaled more than $15,000,000. This amount was saved entirely through the reutilization of tools and miscellaneous equipment, the recovery of useful products from waste materials, and the sale of the unusable residue as scrap.

Included in the $15,000,000 is $4,000,000 realized from the sale of salvaged scrap metal, borings and turnings. In this way, as well as in economical utilization of raw materials, the Ford industries are contributing on a large scale to the conservation of natural resources. The present article deals with the salvage of waste as developed at the Highland Park plant. Economies from the recovery of lumber, coal and ore reduction by-products and glass manufacturing will be described in another article.

FIG. 1 A SECTION OF THE SCRAP METAL SORTING ROOM

Organized work in the reclaiming of waste started nine years ago. Previous to that period, of course, as in all plants, certain items of equipment were refitted for use, or adapted to other purposes, and scrap materials of various kinds were sorted and sold. But about 1916 the decision was reached to find out if the most profit was being realized from this source. Inside of three or four months, possible savings of $150,000 per year were discovered, and from that time on there has never been any question of the value of a special waste reclamation department.

A brief outline of the personnel and the background of this work will aid in understanding the significance of its details as presented further on. In the first place, it receives the cordial co-operation of the entire plant. There is a spirit of earnestness and pride in accomplishment about the entire organization, which probably has a great deal to do with this co-operation. While no one seems hurried (except the tractor drivers who are moving materials), every workman is steadily busy and appears to enjoy his work. This is really a remarkable achievement to have brought about in a plant employing more than 52,000 men, and it does not appear as an artificial attitude nor one enforced by stringency of management.

The workers in the salvage department are particularly characterized by personal interest in their tasks. There are 464 engaged directly in this department at Highland Park, 65 of whom are scattered throughout the plant at baling machines, etc.; 400 others are in the lumber reclamation building; and 139 more are engaged in the work at River Rouge. Many of these men are prevented, by physical disability, from engaging in other occupations. Some are tubercular and must work out-of-doors. Many have been transferred from other departments to this lighter work because of physical deficiencies. A great many more have been hired in full knowledge of their substandard condition. Henry Ford believes in and practices the principle that industry owes every man a chance to make a living if he is anxious to work, and that it is possible to find work for men with almost any physical weakness. His employment department could probably have the pick of men if he cared to enforce high physical requirements, but other plants would then have to absorb an unduly large percentage, or such men would be without jobs. As unemployment from these causes is neither industrially nor socially

sound, the Ford industries, although not hiring men purposely because they are physically below par, will not turn men away solely on this ground, but will give them jobs if there are any open which the applicants can successfully perform.

A balance between the total productive value of such men, and their wages, operating expenses and departmental burden, demonstrates this policy to be not charity but downright good business, as the annual return per man compares very favorably with that of any well-run manufacturing organization. Knowing that they are standing up with healthy men in other lines of factory work inspires the reclamation department personnel with courage and hope, without which no group can function well.

Benefits of Work on the Personnel

It is no wonder, then, that many a physical wreck has been brought back to full health and vigor, able to go back into some regular manufacturing department and make good again, and that many a man with shattered nerves has been reconditioned once more. The lessons learned in salvaging waste materials reflect strangely but effectively on the lives of the reclaimers themselves and have brought many a man, disheartened by a physical breakdown, back again into the full possession of normal vigor.

At the Highland Park plant there are 99,692 sq. ft. of building space devoted to waste reclamation, of which 15,000 sq. ft. are used for the storage of salable material (from scrap, etc.). This latter floor space accommodates a month's supply. Twelve turnovers of material occur annually, about 625 carloads being sent out each month.

All obsolete and worn materials and all scrap and refuse of every kind go to the salvage department. This material ranges from floor sweepings, odds and ends of wood, metal turnings, and the like, to entire buildings that may be dismantled, including all equipment, and even the roofing, lumber, brick and concrete from the structure itself.

The work of salvaging annually 553,000 small tools is carried on in a gallery of one of the main buildings and covers a space of about 1200 sq. ft. Every sort of tool used at the Highland Park plant is sent to this department when its original useful productive life is over. Here it is examined by men who are experts in deciding to what further use each tool can be profitably put. Many tools can be reconditioned for use on the same types of work to which they were formerly devoted. Still others are converted to new uses. Those which cannot be economically reused are sorted and disposed of as scrap. A few typical cases will illustrate the methods followed for tool reclamation.

Dies for the forming of rolled threads on bolts are worn down by use until they are no longer serviceable. These dies are then sent to the reclamation department and in order to be reconditioned must first be annealed. The threads are recut, the dies hardened, and they are ready to go back into service.

Bolt head dies, when worn, are reground. When this method would result in making them too far off size, they are recut to a larger size.

Broaches are made from hammered steel. When worn down, they are reground on the front edge so long as backing stock exists. When this method reduces them below tolerance limits, they are reworked to smaller sizes. Finally they are remelted to be made into bar stock again.

Drills that have been worn down are first usually reground to a smaller size. In some cases where the end is badly damaged they are cut off and ground for use on shorter jobs. It has often been possible to rework a drill so that it will perform two operations instead of one, hence saving in production costs. Some of the drills can be fitted for service again by retanging. Others with a round shank are adapted for use in different collets by flattening a portion of the shank.

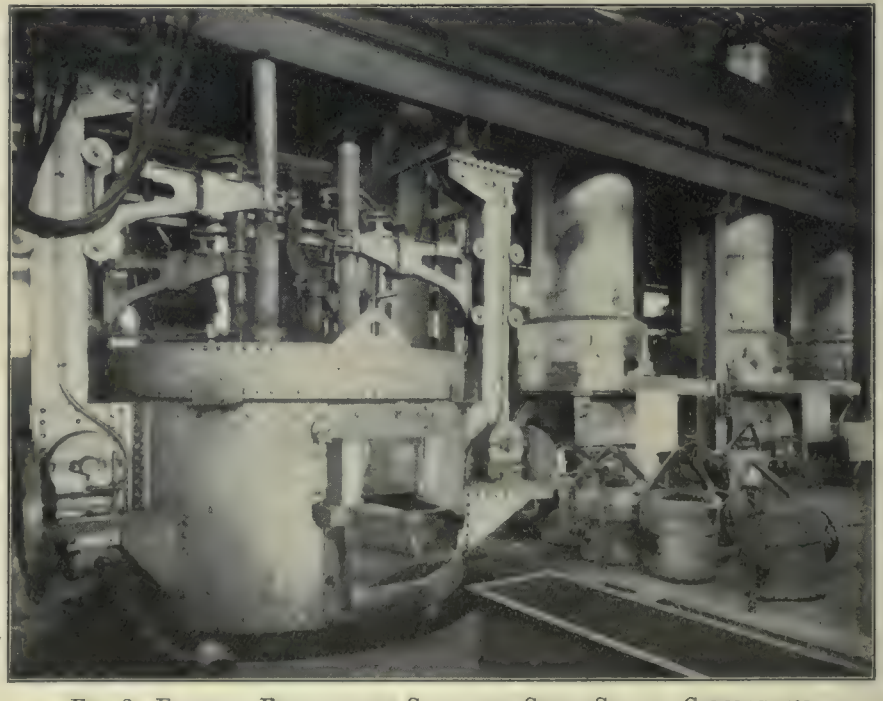


FIG. 2 ELECTRIC FURNACE FOR SALVAGING STEEL SCRAP. CUPOLAS FOR REMELTING CAST-IRON SCRAP

When none of these methods will result in the economical production of a useful tool, the drills are scrapped. As the shank is of carbon steel and the cutting portion of high speed steel, the two portions have to be cut apart by means of a high speed rubber disc.

A very small variation in the analysis of steels causes a wide fluctuation in its qualities and properties, and hence high speed steel and carbon steels have to be separated before they can be remelted as scrap. In

many cases the shanks salvaged are rewelded to new drill bodies instead of being remelted for use as metal. Where uncertainty exists as to the kind of steel in a piece, it is held against a grinding wheel. Yellow sparks denote carbon steel, darker sparks high speed steel.

Reamers go through a reconditioning process very similar to that followed for drills. Often they are reground for slightly smaller jobs. Sometimes they are upset and reworked either to the original size or larger. Occasionally they can be developed for two operations and thereby reduce production costs. When suitable for no further use they are scrapped the same as drills.

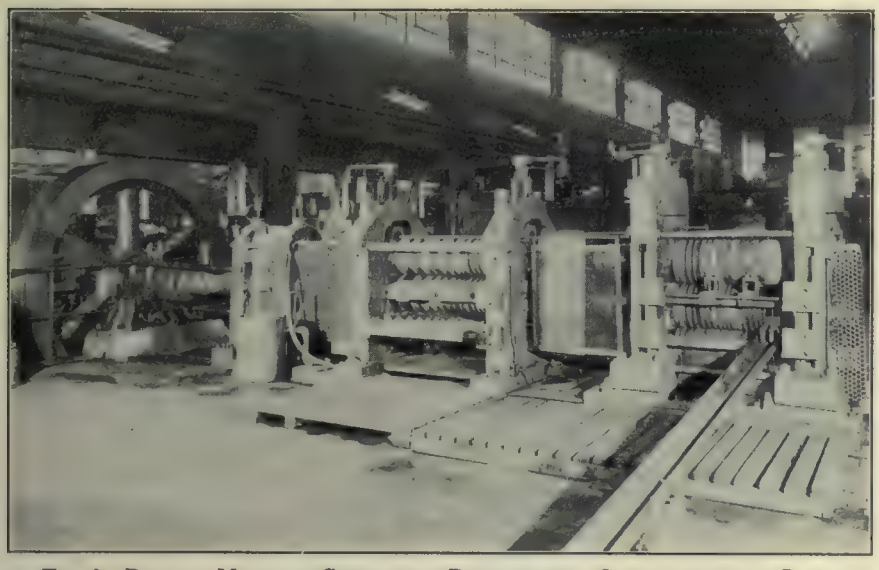


FIG. 3 ROLLING MILL FOR CONVERTING REMNANTS OF STOCK FROM THE DROP FORGE DEPARTMENT INTO USABLE FORM

Gages of various types are constantly tested for accuracy. When these tests show them to be outside of tolerance limits, they are sent to the salvage department and reground for other uses.

Rivet shears, when the blades are worn or broken, are put back into service again by cutting off the old blades and rewelding new ones on in their places.

Hammers of many kinds come to the reclamation department for reconditioning. Copper hammers, used where steel heads would injure the metal on which they are hit, are put back into service by machining off the burred edges and truing up the striking surface. Broken handles are replaced. Raw-hide hammers, formed from rolls of leather, are trimmed off on the battered edges and recut to make the ends plane. Sledge hammers are revamped by truing up the surfaces and fitting them with new handles when the old ones are broken.

The ordinary quick-action screw-driver usually has a lignum vitae handle and bushing. This wood is hard and at the same time needs no lubricant when used in connection with metal. However, it wears down in service and is rather costly. Hence, when it became necessary to repair screw-drivers of this type, a more serviceable material was sought for. Aluminum, as a substitute, has been found to possess far greater wearing qualities with as little need for lubrication, and also is strong enough to resist breakage. Moreover, cost of rehandling and rebushing screw-drivers has been reduced from $1 to $0.49 each by the substitution.

Grinding-wheels are also reconditioned in the salvaging department. When worn down on the edges and irregular on the surfaces they are trued up again. The record for one certain month was 2319 wheels repaired at a saving of $7475.

The tool division of the reclamation department has a complete record of every kind and size of tool used throughout the entire plant. Where tools are of a peculiar nature, drawings are on file showing the dimensions to which they must measure. The record is further increased in value by being departmentalized and by indicating the number of tools of each kind and size required to maintain production in each department. Consequently, when any tool is received in the salvage department a decision can be reached at once as to the most economical way to dispose of it. In the course of time many of these decisions become a matter of routine, due to the familiarity of the various workmen with the plant tool requirements and their expertness in determining the best procedure to follow in individual cases.

Repairs to broken tools save $700 a day. All tools no longer serviceable by the ordinary departmental maintenance methods, such as grinding, etc., are sent to the reclamation department and left entirely at its disposal. To assure the maximum of economy from the entire system, all requisitions for tools are now sent directly to the reclamation department instead of to the purchasing department. From its stores the reclamation department then fills the requisitions so far as it is able. If no suitable tools are in the reclaimed stock, in some cases the demand can be met promptly by adapting and reconditioning scrapped or worn tools on hand. Only after the reclamation department finds that it is unable profitably to fill a requisition, is this requisition forwarded to the purchasing department for the placing of an outside order.

Processes Are Based on Cost Analysis

The reclamation department has become expert not only in determining the routine use to which worn tools should be placed, but also in discovering economical ways to adapt such tools to the needs of special work, to fill unusual requisitions. The aim of the department is not merely to be able to replace tools in service and thereby avoid the purchase of new ones, but to do so by the cheapest possible method and save money over the purchase price. Before any job is actually undertaken, a close estimate is made of the cost involved in reconditioning, especially if a large quantity of material is to be handled or if a job is to be repeated from time to time. Those in charge

of the reclamation department have become very proficient in quickly making accurate estimates of such costs.

An average of 3500 ft. of belting, worth $1000, is reconditioned daily. Belts from dismantled transmissions, and those which have become broken, worn, or oil-soaked in service, are sent to the salvaging department. Here they are cleaned, freed from oil and grease, the worn or broken sections are cut out, and belting of the same size is cemented together and wound into long rolls. Special machines are used for the purpose. Old joints go through the glue scraper, which removes dried cement from the surface. The ends of each piece are run through a scarfing machine which tapers them for splicing. The joints are then glued, pressed and sewed, and the belting is wound into rolls.

Strips of belting and other scraps too short to be assembled profitably into rolls are used to make hand leathers, or are sent to the shoe repairing department to be reworked into the soles and heels of shoes used by men working around hot metal. Smaller scraps are made into gaskets and cup washers for pumps.

Salvaging Shop Equipment

When any shop equipment is dismantled, the parts are sent directly to the salvaging department for storage and reuse. Thus pulleys, hangers, bearings, shafting, etc., are received, washed, and cleaned up, repaired where necessary, and reissued upon requisition for use in other portions of the plant.

Bushings which have been removed from machinery are sorted and reused, or if badly worn are repaired for service.

Valves of all sorts are brought into the reclaiming department for cleaning, repairing and readjusting. Broken handles are replaced; belt spindles are straightened; worn seats and discs are reground; battered threads are recut; or broken flanges are welded; and when thoroughly cleaned up the valves are ready for utilization again.

Conduit for electric wiring, and pipes of various kinds, are brought into the department when removed from service, and repaired for further use. Bad sections are cut out and scrapped. The good portions are rethreaded on the ends and placed in stock. Short sections are coupled together to form standard 10 ft. lengths. Pipe fittings are cleaned, threads chased when necessary, inspected and placed in stock.

Worn-out flashlight batteries are taken apart and the zinc is salvaged. The rest of the material cannot be economically reused, and hence is scrapped.

Fuses for electric circuits are reconditioned by the installation of new cartridges; when too far gone for further use the metal is salvaged as scrap.

Bolts and nuts with worn threads are cleaned and recut. Over one ton of these is reclaimed per day.

Mop pails that have become battered in service are reconditioned. If the pail itself is so badly damaged that it is not worth while to fix it, the attached mop wringer is removed and put on a new pail.

All scrap metal is sorted before final disposal. If it is to be reused within the plant, this work is necessary to allot it to its proper place. If it is to be sold to dealers it brings a much higher price sorted than if sold as miscellaneous material. All broken machine parts, and castings which have been spoiled are classified in large bins as heavy scrap, shoveling scrap, etc. (See Fig. 1.) Steel parts are separated from cast iron and are classified according to the nature of the metal. Short pieces of structural steel shapes which are too small to be readily utilized go into scrap.

Babbitt and lead from worn-out bearings are removed and remelted. In this process a scum known as dross collects on top of the molten metal. This was found to be salable to junk dealers at a good price, and hence attention was directed to the possibility of reclaiming it within the plant. After careful study a new and suitable process was worked out for the purpose and has resulted in the saving of $2400 per day.

Brass parts are sorted out from scrap metal and sent back to the brass foundry. A special department is given over to handling of brass borings and turnings. After the water, introduced in machining, is extracted by a centrifugal process the chips are sent to the Highland Park brass foundry for remelting. About 65,000 lb. are handled daily.

Sheet brass scrap from the punch presses is collected and delivered to a baling machine. Here it is compressed into bales for remelting. Two men bale six tons per hour.

Reclamation of Steel Scrap

Steel borings and turnings are also gathered from various departments, and, after going through a centrifugal machine to separate out the cutting oil, are loaded into freight cars and sent to River Rouge for remelting. (See Figs. 2 and 3.)

Strips of metal from which parts have been punched, and other refuse from the power presses are collected in trucks and delivered to a baling machine. Here the scrap material is unloaded on a dumping platform in quantities for convenient handling. This platform, by means of a lever, is tilted and discharges its contents into the baling receptacle, the top of which is then closed down. A hydraulically operated plunger moves forward and compresses the metal into a compact bale, about 18 in. long, 12 in. wide and 10 in. thick. This bale is then ejected onto a conveyor which carries it up and dumps it into a waiting freight car. When this car is loaded it is taken by railroad to the River Rouge plant, where the material is charged into the foundry cupolas again. Eighteen tons of steel scrap are baled during eight hours by five men. Two large steel baling machines handle an average of 25 tons every eight hours. Including borings and turnings, 400,000 tons of steel scrap are handled each year.

Cast-iron borings and turnings are likewise collected, and sent back to River Rouge in freight cars, there to be boxed in metal containers and melted over again in the cupolas.

Certain metals are received in a mixed state and it does not pay to sort them; they are therefore sold to dealers as uncleaned scrap.

(To be concluded in a subsequent issue.)

Profitable Export Market Analysis

Methods of American Automotive Manufacturers

By GEORGE F. BAUER

Secretary, Foreign Trade Committee, National Automobile Chamber of Commerce

RESEARCH into automotive export markets has for its purpose the establishment of guides for intelligent direction and business promotion along lines that will be least wasteful and most profitable.

The conduct of foreign business involves distance, dissimilarity of language, changing conditions and large expenditures. There is, too, the possibility of employing more men than are actually needed, diversion of energy and unwarranted tying up of money in expansion unless the policies providing business promotion and organization are based on as sound facts as can be found regarding the foreign markets in which operations are undertaken.

Research a Science of Facts

Research accordingly will be found, as regards automotive export trade, to be truly a science of facts. It will involve an organization for the collecting of facts; definite decision as to the kind of facts needed to be of greatest benefit; presentation of facts in a manner that is readily grasped; and practical application of the facts with a view to assure efficient direction and profitable conduct of business.

Automotive export research is done collectively for the industry as a whole and also is carried on separately by companies along lines that coincide with their particular policy. The need for export research for the industry as a whole arises because certain factors affect alike the foreign business of all motor vehicle manufacturers, and consequently it is necessary for each of them to know what obstructions in general hamper the expansion of motor transport in various parts of the world, before engaging in intensive campaigns of business promotion abroad.

It is evident that fundamental information to be of real value must be supplemented from time to time by current data. It must also cover all factors that could possibly affect the sale of American motor vehicles in every foreign market of the world. Furthermore, there must be facility for its constant accumulation for future reference and utilization in the devising of policies.

To supply this service of general use to all automotive manufacturers, a basis of co-operation has been effected between automotive trade associations and the Departments of Commerce and State. This arrangement was especially facilitated by the establishment, under the guidance of Secretary Hoover, of different commodity divisions. The Automotive Division, aided by more than 400 government officials abroad, is excellently qualified to carry on research of such factors as bear in general on exports of American motor vehicles. Fig. 1 shows the course of collecting and compiling the information required by manufacturers.

An organization set up to handle research for the benefit of an individual company will naturally vary according to policy and scope of foreign operations. Some firms will carry on export research in conjunction with their other duties. Other companies may, however, deem market research highly essential, warranting the employment of an expert and a staff of special assistants.

Such a liberal policy toward foreign research is taken by the General Motors Export Company, which is responsible for the merchandising of all automobiles manufactured by the General Motors Corporation outside of the United States and Canada. Louis de La Garde, Assistant to the General Sales Manager, is head of the research activities and is assisted by men who have been abroad and who are actually conversant with conditions in various parts of the world. In addition, there are traveling representatives whose co-operation may be secured in connection with any questions pertaining to their respective territories.

Determining What Facts Are Essential

The next step following organization for research work for the industry as a whole consists in definitely determining what facts are essential to assure the proper analysis of marketing problems. Much thought was given to this phase by officials of the United States Automotive Division and various representatives of automotive companies, with the result that an outlined guide was perfected with detailed headings of practically all subjects believed to have a bearing on expansion of motor trade and transport. Copies were then sent to all of the government representatives abroad and are now used as skeleton outlines for reports by them on automotive developments in their particular sections. Table 1 lists the essential points upon which data is collected. By securing this information (detailed instructions for which are given under each of the headings contained in the table) and covering the specific subjects referred to in the guide, these men

get out reports that are of greater value to the trade than if they had to depend solely on their own judgment.

Individual companies, however, may sometimes be interested in securing information of a little different type and proceed to do so on their own initiative. Thus, the General Motors Export Company makes world studies in the home office, and as its first important step decides what particular information is most desirable for arriving at conclusions, and what data, when collected, will show the most immediate returns in dollars and cents.

The initial objectives, as fixed after considerable deliberation, consist in finding out:

Where are the motor cars of the world?
How many are there in each market?
Who sold them?

Information on the first question serves in indicating where the major markets exist. In the answer to the second is found the relative importance of the various car markets and also the places in which energy of men and outlay of money might be applied with likelihood of ultimate benefit. Data on the third serves as a check-up on past performance and indicates whether the cars and trucks were sold by the company or by its competitors. By knowing who sold the motor vehicles, it is considered possible to find out why and how they had been sold and in what way, if any, and why, the company's efforts had been inadequate.

It is extremely important for the company to know what percentage of the total market it is getting; whether it is doing better than last year; and also whether its percentage of the total available market has increased or decreased. The market analysis investigation will disclose whether the share of the company is 1 or 50 per cent of the total market. Knowledge of this latter fact is particularly important, as a merchandising corporation may, in a rapidly expanding market, increase its sales 25 or 50 per cent and yet lose out as regards its share of the total available market.

In addition to the data on these three principal phases, efforts are also made to collect other information, even on economic subjects. It is felt, however, that probing too deeply into the economic side of market analysis is not generally warranted because of the doubtful returns for the cost of the larger amount of work that becomes necessary. Then, too, considerable difficulty is experienced in getting information that is dependable and up-to-date, as statistics compiled by many foreign countries are very often lacking in those qualities and in only a few instances are comparable.

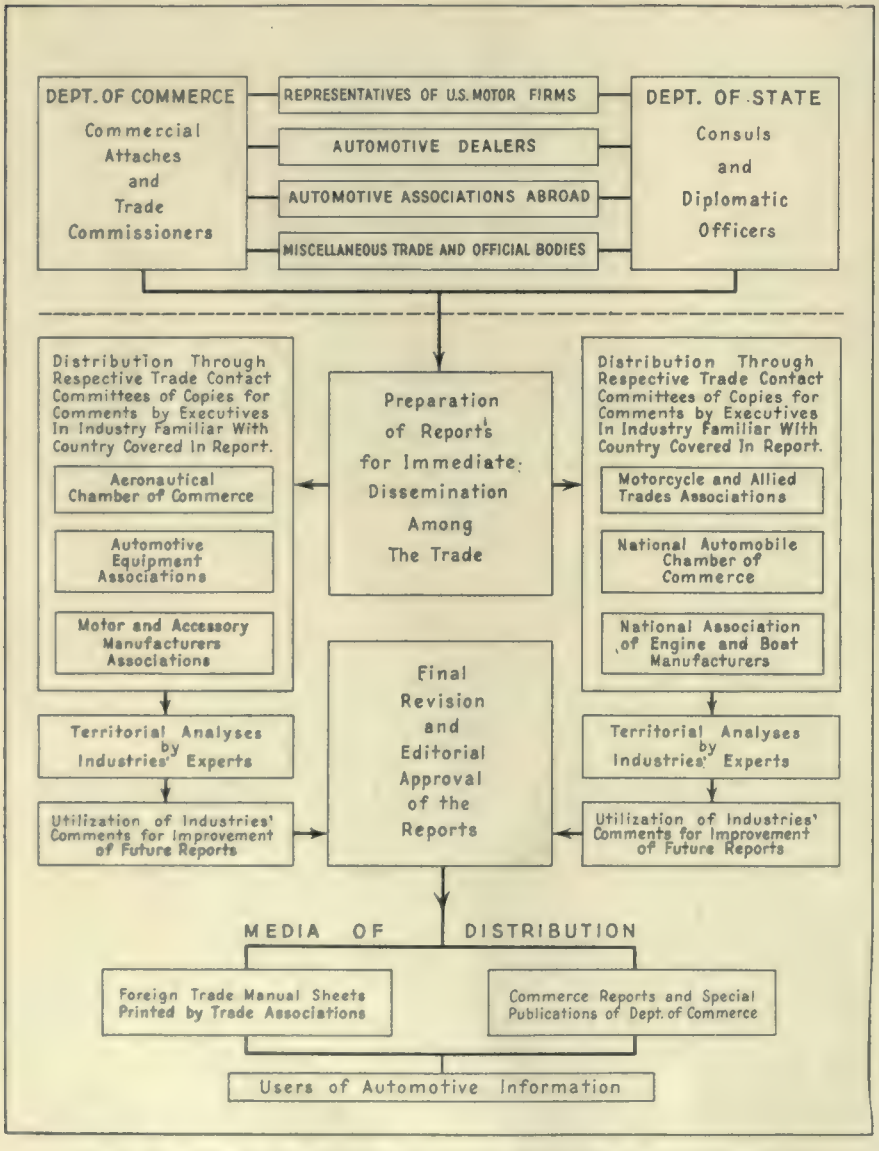

DEPT. OF COMMERCE
Commercial Attaches and Trade Commissioners
REPRESENTATIVES OF U.S. MOTOR FIRMS
AUTOMOTIVE DEALERS
AUTOMOTIVE ASSOCIATIONS ABROAD
MISCELLANEOUS TRADE AND OFFICIAL BODIES
DEPT. OF STATE
Consuls and Diplomatic Officers
Distribution Through Respective Trade Contact Committees of Copies for Comments by Executives In Industry Familiar With Country Covered In Report.
Aeronautical Chamber of Commerce
Automotive Equipment Associations
Motor and Accessory Manufacturers Associations
Preparation of Reports for Immediate Dissemination Among The Trade
Distribution Through Respective Trade Contact Committees of Copies for Comments by Executives In Industry Familiar With Country Covered In Report.
Motorcycle and Allied Trades Associations
National Automobile Chamber of Commerce
National Association of Engine and Boat Manufacturers
Territorial Analyses by Industries' Experts
Final Revision and Editorial Approval of the Reports
Territorial Analyses by Industries' Experts
Utilization of Industries' Comments for Improvement of Future Reports
Utilization of Industries' Comments for Improvement of Future Reports
MEDIA OF DISTRIBUTION
Foreign Trade Manual Sheets Printed by Trade Associations
Commerce Reports and Special Publications of Dept. of Commerce
Users of Automotive Information

FIG. 1 COURSE OF MARKET DATA FROM SOURCE TO MANUFACTURER

Market Analysis by Field Men

A plan of market analysis by the field men of the company is provided. This plan necessitates data of a broader character than do the home studies. Various facts regarding a certain territory under the field man are sought: Geography, population, agriculture, minerals, fisheries, mechanical power resources, manufactures, commerce — domestic and foreign, political situation, and communication. Automotive factors of gasoline, oil, duties, selling seasons and special taxes are also stressed.

Statistics of interest pertain to registration of cars and trucks, by totals, provinces, makes, and distributor and dealer zones. Facts for determining ideal distributor and dealer zoning are also desirable. Others, obtainable only by the company and used as territorial controls,

TARIFFS PERU

IMPORT DUTIES

IMPORT DUTIES

		Sol per kilo
1502	Automobile Trucks	0.01
		Ad valorem
(1) 1503	Passenger and tourists' cars not exceeding 500 Peruvian pounds in value	15%
1503a	The same as above, valued at from 501 to 1500 Peruvian pounds.....	25%
1503b	The same as above, valued at more than 1500 Peruvian pounds.....	35%

(1) When chassis and bodies of automotive vehicles are imported separately, the duties are at the same rate as for the automobile complete.

BASIS OF DUTY ASSESSMENT

Dutiable weight of trucks is gross weight.
Dutiable value of passenger and tourists' cars is market value in country of origin plus 20% for transportation, and related charges.

CUSTOMS SURTAXES

At Paito, Pisco and Talara the surtax is 20% of the duty.
At Callao it is 19% and at all other ports it is 18%.

PREFERENTIAL DUTIES

None.

Continued on page 1343

4/27/25 1342

FIG. 2 SAMPLE PAGE FROM AUTOMOTIVE FOREIGN TRADE MANUAL

relate to distributor stocks at the beginning of each month, receipts during month, average stock for month, sales for month, firm orders and estimates on file, orders estimated per budget, and shipments en route.

A frequent problem, after facts are once obtained, consists in preserving them for future use. This is accomplished throughout the automotive industry by means of loose-leaf manuals. Fig. 2 shows a sample sheet, 6 x 9 in., from one of these books. The Society of Automotive Engineers has employed a similar method to enable its members to preserve in a systematic manner a mass of research data pertaining to the technical part of the business.

There were certain needs peculiar to foreign trade that also contributed to the final adoption of the manual system by the Department of Commerce Automotive Division to make more of its reports available to the industry. Timeliness was one. Reports are prepared on loose-leaf sheets and need not be retained for incorporation in a pamphlet. If completed today, the sheet with the export data can be in the hands of an executive tomorrow. The information, because of this timeliness, is enhanced in value to the business man, who can immediately take action on it in extending his plans for the further development of foreign sales.

Accessibility to information for future use is also afforded under this manual method. On each loose-leaf appears information pertaining to but one country, and one main phase of an industry. When the country differs, or if even the subject of the report begins materially to change, additional sheets are prepared to afford segregation of the information according to different countries and character of substance. As the information is brought up to date, change sheets containing more recent, or more complete, reports are made to replace the obsolete ones. The sheets, indexed according to country and subject before their receipt by the executive, are given a fixed place in the manual, which has a geographical tab index where the information may always be found and consulted as occasion demands.

Conservation of time and work on the part of the exporter is another benefit that accrues from this manual system. The benefit from this conservation of effort is better appreciated when it is realized that the facilities of some companies as regards exporting are very limited. In numerous instances, export promotion is carried on by but one person, who may even be obliged to do the major part of the clerical work in that connection. Unless data is made available to overcome these limitations, much of it would become valueless for ultimate use in research studies.

General Motors Export Company Methods

The General Motors Export Company employs a similar system which is suitable for its purposes, and arranges to keep a master copy of each study of a foreign market—comprising usually from 50 to 70 pages—in a loose-leaf binder. By this means it is kept up to date by slight changes and additions.

It is essential, after collecting data, to portray vital facts graphically so that a conclusion can more readily be drawn in formulating future policies. At the World Motor Transport Congress, held in Detroit last May, a uniform method of presentation was used for all factors to allow for comparisons between different countries. A simple bar chart was adopted for every factor, the separate bars designating favorable or unfavorable degrees in the various countries.

Thus, a bar chart, Fig. 3, shows the cost of gasoline in various countries. Where the price of fuel is highest the sale of automobiles, from this standpoint, is most difficult. Hence, the longer the bar, the greater the sales obstacle. In cases where data is not available the corresponding space is left blank.

Another bar chart shows the number of inhabitants per automobile. In countries where the bar is small the deduction is drawn that the population is favorably situated with regard to purchase of motor vehicles. If the bar is high, it is inferred that the opposite is the case.

Square miles of area to mile of "motorable" road in the different countries show whether all or part of areas of land are readily accessible by road. Abundance of roads is indicated by a small bar, whereas lack is revealed in one of considerable height, representing an

obstacle to be overcome in order to attain greater development of motor transport.

Servicing facilities present themselves also in the form of an automotive factor. Availability or lack of battery service stations will considerably influence absorption power of a market, in that magneto equipment may become necessary and tend to increase cost of motor transport. This factor is graphically presented for comparative purposes in a bar chart on the basis of cars to battery service stations.

TABLE 1. OUTLINE OF INFORMATION REQUIRED FROM FIELD OFFICERS

1. Automotive Market:
   Development;[1] extent of market (registration); potentiality (percentage of population classed as possible buyers in next 5 years); roads; fuel; position of American cars; imports.
2. Business Practices:
   Shipping; packing; warehousing; distribution; sales practices; banks; advertising and sales promotion; exhibitions and contests; associations; government purchasing agencies.
3. Passenger Car Market:
   Competition; prices; preferences; prospects; specialties.
4. Current Conditions (for monthly reports):
   General business situation; imports; assemblies; market conditions; roads; outstanding developments (such as bus lines, motor service on railways, etc.).
5. Manufacturing:
   Data on assembling plants situated in country; body building; local manufacturers; statistics (for entire industry and for such companies as possible).
6. Motorcycle Market:
   Extent of market; potential factors; preferences and requirements; competition; selling methods.
7. Regulations:
   Traffic restrictions on motor vehicles; rules of the road; construction requirements; registration; operators' licenses; touring licenses.
8. Parts—Accessories:
   Accessories and specialties; local manufacturing; parts (dealers' stocks and local manufacture); electrical equipment.
9. Public Vehicles:
   Taxicabs; buses.
10. Service:
    Practices and facilities.
11. Truck Market:
    Competition; prices; preferences; sales practices; operating field; hauling charges; transportation lines; trailers; special equipment.
12. Airplane Market:
    Registration; imports; competition; uses; manufacturing.

[1] Under each of these subheadings throughout the questionnaire, detailed information is given as to the nature of data to collect.

Additional factors that bear on expansion of motor transport are similarly presented as bars indicative of obstacles. Among these are such factors as per capita wealth, duties and freight charges.

Other methods of graphic presentation employed by motor companies include graphical maps, outline maps showing distribution and density of automobiles and trucks, distribution centers showing cities of 5000 and upward, and similar facts.

Sales divisional control charts are also used to give the general sales manager and other senior executives an immediate and accurate picture of a company's position. These charts show by colored tacks the monthly performances in orders against budget by zones and by distributor, stocks on hand, sales for last month, cost of sales per $100 of merchandise sold by zones, and field men's movements.

Much of the advance in automotive exports may be attributed to scientific study of problems and means of solution. The work appears to be well rewarded in the fact that automotive products rank first in the export trade of manufactures from the United States. In fact, foreign markets absorb as many cars annually as are sold in 24 states of the Union.

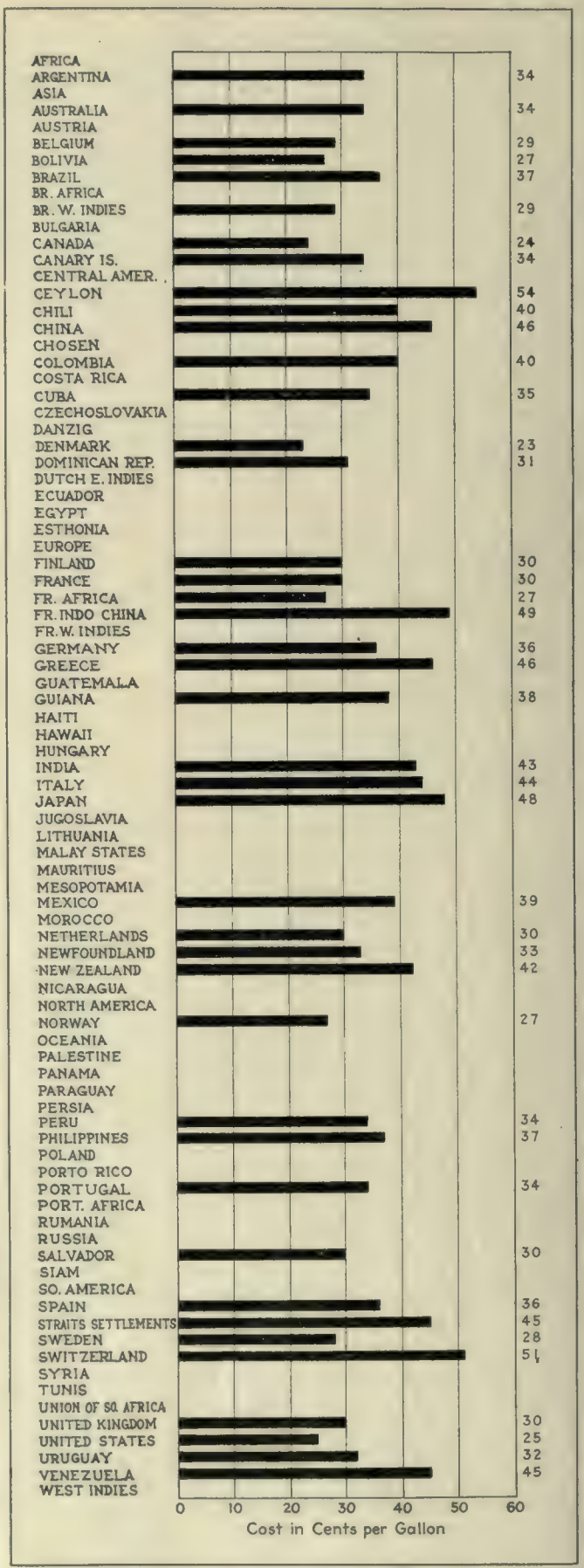


FIG. 3 CHART SHOWING COST OF GASOLINE IN VARIOUS COUNTRIES

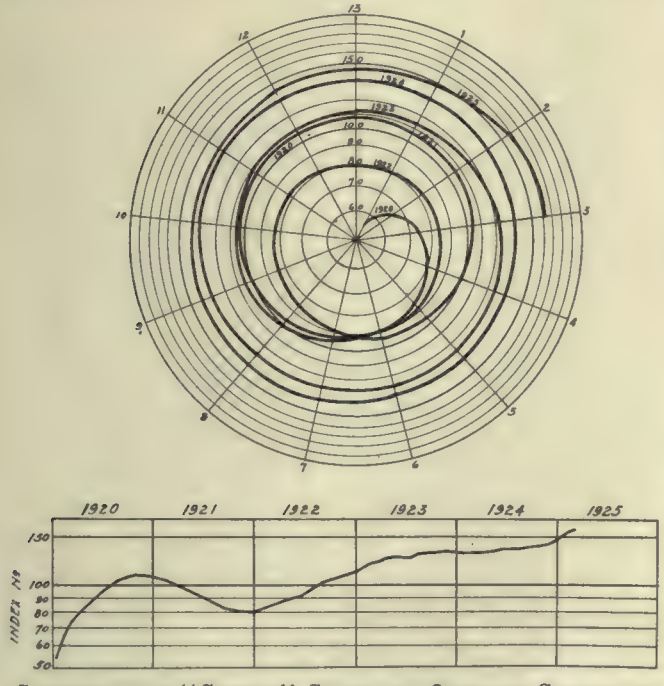
The Cobweb Chart

By J. B. CONWAY

The Fulton Company

SOME time ago, in casting about for a graphic chart that would present some pay-roll data in a form different than the results obtained by the use of the conventional charts, it was decided to try a modification of the "pie" chart. The result was a chart very similar to the "cobweb" chart by Walter N. Polakov.[1] However, the chart did not lend itself well to the plotting of the data and was rejected, at least temporarily.

After reading the article referred to above, the idea was suggested that such a chart might be useful in connection with moving averages. A test was made with the moving average for sales, with the result shown in the accompanying chart. Similar data for the pay-roll were available, but owing to the less rapid increase, as compared with sales, the spread between the lines of the curve would not be great enough to avoid confusion in reading the chart.



COMPARISON OF "COBWEB" CHART AND ORDINARY CO-ORDINATE CHART IN PRESENTING SALES DATA

The curve shown represents the values of the moving average of the sales index numbers, after correction for seasonal variations and secular trend. The divisions, 13 in number, represent the periods into which the working year is divided, as this base, instead of 12 months, is employed, thus giving equal periods of four weeks each. The concentric circles are laid off to a logarithmic scale which has a further tendency to smooth the curve.

This chart contrasts well with the one presented by Mr. Polakov in that these data are for an increasing series, whereas the former were for decreasing values. So that, instead of the origin of the sales curve being near the perimeter of the chart, it is near the center, and "unwinds" as it approaches the higher values. This same difference in direction of trend is also apparent when the curves are plotted on co-ordinate paper.

A comparison of the charts herewith with Mr. Polakov's chart will readily disclose the adaptability of the "cobweb" chart for certain data, both for an increasing and a decreasing series. As pointed out in the former article, the radii may be graduated equally or on a logarithmic scale. This would depend, of course, on the values of the data to be plotted.

There is one disadvantage in the use of the "cobweb." When the data are such that the course of the curve crosses and re-crosses, as does the sales curve, and does this without considerable variation, the proximity of the "lines" of the curve makes for confusion in reading the chart. Further, when there is a dip in the curve, as in the year 1921, which caused the origin of 1922 to fall below the origin of 1921 and 1923, the chart is rendered more complex.

Whether or not the "cobweb" chart is adaptable to the data at hand may be determined by sketching the general trend of the curve on co-ordinate paper and observing the differences in variation of the high and low points. It is believed that this chart, with that of the above mentioned, both containing data that are widely different, is fairly representative of the uses that may be made of this construction.

[1] See MANAGEMENT AND ADMINISTRATION, March 1925, p. 277.

A Practical Lot Quantity Formula

THE article by Ralph C. Davis in MANAGEMENT AND ADMINISTRATION for April develops in considerable detail formulas for determining economical lot quantities for manufacturing purposes. He considers all factors that have any influence on the result; and his final formulas are, without doubt, theoretically correct, and would furnish solutions accurate to the same extent that the factors used in any particular case are correct.

The complexity of the equations necessary to obtain accurate solutions, however, might discourage many from using this means of determining lot quantities. Especially is this true since few concerns would be able to get accurate figures for the various factors used in the formulas, nor would many concerns be interested in results closer than the nearest 100 when several thousand pieces are to be made.

For these reasons, it may be of value to compare these formulas with a simple formula developed by an employee of the General Electric Company for the purpose of controlling manufacturing orders in one department of that company.

This formula is:

$$Q = \sqrt{\frac{400RA}{C}}$$

Q = Economical lot quantity, as in Mr. Davis' formula, but expressed in thousands.

R = Rate of consumption per month expressed in thousands, or $S/12{,}000$ in terms of Mr. Davis' factors.

A = Total set-up and preparation cost.

C = Cost of parts per thousand or $1000C'$ in terms of the Davis formula.

I is considered to be 0.06.

To demonstrate the similarity of results obtained by these formulas, several examples are worked out. The example given in Mr. Davis' article is solved by the simpler method:

$$R = S/12.000 = \frac{20{,}000}{12{,}000} = 1.667$$

$A = \$605$

$C = 1000C' = \$10{,}000$

$$\text{Then } Q = \sqrt{\frac{400RA}{C}}$$

$$= \sqrt{\frac{400 \times 1.667 \times 605}{10{,}000}}$$

$$= \sqrt{40.3414}$$

(1) $= 6.352$ thousand pieces.

The difference between this answer and that of 6621 pieces, obtained by Mr. Davis, is 269, or slightly over 4 per cent.

Assume another set of conditions:

Let $S = 5000$

$M = 25{,}000$

$C' = \$5$

$F = 1$

$I = 0.06$

$A = \$250$

$$\text{Then } K = \left(\frac{M+S}{2MS}\right) C'I$$

$$= \left(\frac{25{,}000+5000}{2 \times 25{,}000 \times 5000}\right) 5 \times 0.06$$

$$= 0.000036$$

$$Q = \sqrt{\frac{A}{K}}$$

$$= \sqrt{\frac{250}{0.000036}}$$

(2) $= 2636$ pieces

By the simple formula:

$R = 0.417$

$A = \$250$

$C = \$5000$

$$Q = \sqrt{\frac{400 \times 0.417 \times 250}{5000}}$$

$$= \sqrt{8.34}$$

(3) $= 2.885$ thousand pieces.

Difference this time is 249 pieces, or 8.6 per cent.

One more example:

Let $S = 10{,}000$

$M = 100{,}000$

$C' = \$10$

$F = 1$

$I = 0.06$

$A = \$100$

Then $K = 0.000033$

$$Q = \sqrt{\frac{100}{0.000033}}$$

(4) $= 1741$ pieces.

By the simple formula:

$R = 0.833$

$C = \$10{,}000$

$$\text{Then } Q = \sqrt{\frac{400 \times 0.833 \times 100}{10{,}000}}$$

$$= \sqrt{3.332}$$

(5) $= 1.826$ thousand pieces.

This time there is a variation of 85 pieces, or 4.9 per cent.

These examples demonstrate that, although to obtain absolute accuracy the formula developed by Mr. Davis is necessary, results close enough for manufacturing purposes can be secured by use of the simpler formula. This latter formula entails considerably less labor in arriving at a solution and, in fact, whenever, as will usually be the case, the nearest 100 pieces is sufficiently close, slide-rule computation will give satisfactory results in very brief time. As an example, when a slide rule is used for computation, equation (1) results in 6.350, compared with 6.352; equation (3) gives 2.890, compared with 2.885; and equation (5) gives 1.830, compared with 1.826.

Electric Heat to the Rescue

By S. L. LANG

Vice-President, Wolfe Brush Company

ELECTRIC heat is proving its value for the Wolfe Brush Company. We have been manufacturing high-grade brushes for many years. In 1919 we adopted electricity for heating our melting pots and ovens, and found, in both cases, that our step was justified.

The composition which fastens each bunch of bristles into the holes in the wooden back is heated in a cast-iron melting pot, 18 in. in diameter and 8 in. deep, mounted in the middle of a work table. Electric heat superseded gas for this process, with the result that working conditions have been greatly improved and fire hazard decreased. The difficulties arising from shortage of gas pressure have also been eliminated.

Three Westinghouse steel-clad heaters are fastened to the bottom of this melting pot. The total wattage is 1950 watts. Asbestos cement 1 in. thick insulates the pot and conserves heat. This insulation is protected by a galvanized iron shell. Air is exhausted from over the top of the pot through a 4 in. galvanized pipe by means of a ventilating fan.

FIG. 1 ELECTRICALLY HEATED MELTING POT

Small bundles of bristles are dipped into a solution and then inserted in the wood base.

The heat is controlled by a 3-heat snap switch. The composition is melted on a high heating rate in the morning and then kept at the proper working temperature on a medium heating rate.

The electric oven used for baking the brushes superseded a gas-fired oven. Gas was found to be unsuitable because of the difficulty of maintaining proper temperature, and because of smoke, soot, fire hazard, and the unreliability of gas pressure.

FIG. 2 ELECTRICALLY HEATED OVEN

The ovens are used for vulcanizing the compound in which the brush bristles are set. The bristles are first arranged in thin metal ferrules with the root ends projecting about ½ in. The roots are dipped in cement and the ferrules are then slipped over them, far enough to allow the proper insertion of the handle after the cement has been baked. The baking is done with the bristles in an upright position.

In order that the high quality of these brushes be maintained, it is necessary that this baking be done at the proper temperature. Over-heating destroys the life of the bristles and makes them break off. We have found that electric heat permits us to maintain a very close temperature regulation, between 216 and 230 deg.

The average charge consists of about 60 dozen brushes, weighing about 250 lb., per bake. The brushes are placed in the oven in the morning and baked 10 hr. About 3½ hr. of this time is required for heating up. Before we adopted electric heat, we found that it sometimes took three or four days per bake in periods of low gas pressure. Since electric heat has been installed, there have been no delays.

Electric heat is helping us maintain the high quality of Wolfe brushes and removing some of the cares and troubles of our manufacturing processes.

Long Distance Heating

By L. V. CURRAN

Superintendent of Power, Tennessee Copper Company

THE plant of the Tennessee Copper Company covers about 40 acres. Scattered about this space are many isolated tanks, buildings, etc., that need heat. We recently came to the realization that, by using steam for heating these isolated places, we were heating up almost the whole out-doors. In order to reduce these losses, we decided on some extensive changes in our equipment. The first step was the grouping, as far as possible, of our shop offices, operators' shacks, etc. They were then equipped with electric heaters. We found that a heater taking approximately 1200 watts will keep a shed 5 ft. by 4 ft. by 7 ft. high comfortable when the outside air is about 10 deg. fahr. The heaters are convenient, easy to install and dependable. There is no danger of their starting a fire.

In the laboratory, we replaced steam hot plates by electric hot plates. The steam coils in the water still were replaced by bayonet heaters, and those of the sample dryer were taken out, and electric steel-clad heaters substituted. In hospitals, also, we turned to this clean, safe form of heat. The sterilizer steam coil was removed, and a bayonet heater substituted. A disc heater is now used to heat the instrument sterilizer. In both the laboratory and the hospital, we found that, in addition to being clean and safe, electric heat is convenient and dependable.

We find that these electric heaters are saving us money. Under the old system, the long steam lines were expensive to put up; maintenance costs were high; and losses in the lines and trap were so great that the useful heat was but a small fraction of the losses. Now we are sure that the energy is utilized efficiently and maintenance costs are negligible. We are getting heat when we want it, where we want it, and as we want it.

THE EDITORS' PAGE

A Museum of Engineering

REPORTS in the daily papers that Orville Wright intends to place the airplane used by him and his brother in their epoch-making flights at Kittyhawk in 1903 in the South Kensington Museum in London, has again focused attention on the possibility of an American museum of engineering. In this respect we are far behind Europe, which has four such institutions, one in London, another in Paris, a third in Vienna, and the largest of all, the Deutsches Museum, in Munich.

There are a multitude of reasons for, and seemingly none against, the establishment of such a museum, or better, a group of such museums in the great industrial cities of the United States. The first reason that such an institution should be custodian of the originals of epoch-making inventions and discoveries is overshadowed by educational advantages. The development of the factory system has shut our young people away from any knowledge of industrial processes. Formerly home industries flourished and every boy and girl knew at first hand how many of the common articles of everyday use were produced, the materials which were used, and the nature and quality of the product. Today, with manufacturing hidden behind factory walls, no one except the specially favored has any knowledge of industry as a factor in everyday life, and the dependence which we all have upon its orderly, uninterrupted operation.

Museums of engineering and industry can reveal to all our basic industrial processes and operations, and thus become a great factor in enlightening our people. Knowledge and understanding secured in this way may be a most potent factor in stabilizing our industrial, social and political institutions, and even making permanent our present-day civilization.

It is most earnestly to be hoped that the efforts now being put forth to arouse interest and bring about the establishment of such museums in the United States may not fail. Industrial managers should have an interest in the project, for nearly every plant has some relics of invention and discovery which might properly find a permanent home in such a museum.

The Passing of Hand Labor

THE selection of equipment to best conserve the dollars invested in an enterprise is a matter of prime importance. Improvements in machinery are constantly being developed, especially to replace hand labor, and no good opportunity to make use of such equipment can profitably be overlooked. Means are now at hand to measure, in advance, the probable savings from a new equipment installation and the amount of investment which is justified.[1]

In the handling of materials, economies are of the utmost importance. Handling charges often are the largest item in manufacturing costs, yet how many executives actually realize that they have a material handling problem before them and make a determined effort to attack and solve it? Hand labor in this field is no longer economical where equipment has been developed to take its place. As pointed out, while the Chinese coolie is about the cheapest workman on earth in wage rate, his work can be performed at one-twentieth the cost by mechanical equipment.

Foundry operation involves the handling of around 168 tons of material and equipment for every ton of castings produced.[2] This ratio has its parallel in almost every industry. How many times must the same piece of metal, leather, textile, or lumber, or the same lot of food products, or other bulk material, be lifted, lowered, and moved from operation to operation, before it is finally ready for storage or shipment?

This problem of low-cost handling has been effectively solved in the new plant of the Standard Milling Company, described in an article by A. P. Walker in this issue. Convenience, speed, flexibility and reduction of cost have all been obtained, and very little labor will be required in receiving, processing, storing and shipping of flour, due to the equipment within the plant, and the railroad siding, dock and trucking platforms by which it is served.

There is no need, however, for an executive to wait until he has occasion to rebuild his plant before he introduces up-to-date handling facilities. An old plant, as well as a new, will make more money by abandoning antiquated hand-labor methods and gaining the advantages which material handling equipment insures.

Making Waste Pay Profits

THE elimination of industrial waste either by prevention or salvage occupies an important position in the public mind at present. No dissenting voice has been raised against the oft repeated assertion that waste is largely unnecessary, and can and should be eliminated. There is some doubt, however, as to just how this objective is to be attained. Waste prevention requires a careful study of the product, of manufacturing and distribution processes, and, in general, is a long and sometimes costly procedure. That it is a profitable project few will deny, but the relative difficulty of so ordering all industrial processes that unnecessary waste is prevented inhibits many concerns from taking the step.

The salvage of waste, on the contrary, seldom requires any great amount of study, and produces immediate and profitable results. There is no reason why any

[1] See *Mechanical Engineering*, May 1925, pp. 402-415, for articles on "Formulas for Computing the Economies of Labor-Saving Equipment" and actual application of the formulas.

[2] See *Open Shop Review*, April 1925, pp. 153-161, "Handling 168 Tons for Every Ton Produced," by Max Sklovsky.

industrial plant should fail to reclaim such of its waste material as can be reworked profitably, and there are few items of waste which do not belong in this class.

The possible revenue from this source is staggering. The statement of Secretary Hoover, mentioned in these pages three months ago, that $600,000,000 is being saved each year, is beyond the immediate comprehension of most of us. The sum is so great that it loses its full meaning. The information given in this issue about the Ford salvage work is readily understood. Waste reclamation saved $15,000,000 in one year—$7.50 for every Ford car manufactured—nearly 2 per cent of the selling price of a fully equipped auto. Those figures tell a real story of the value of salvaging work. In the May issue, A. S. Kelligon told how the Southern Pacific Railroad saved over $600,000 in a single year by waste reclamation.

Not only do these articles emphasize the profit-making possibilities of salvage work but, together with the section of "Management's Handbook" contributed by C. B. Auel, they provide innumerable practical suggestions for profitable reclamation of many specific material items, some of which are present in every plant's waste pile.

Big Power Savings at a Small Cost

WHERE power costs are a large factor in manufacturing operations, close attention to the most economical means of generation is a vital matter. Even where the processes do not involve large expenditures of power, or the use of steam directly in production, a study of methods and equipment rarely fails to indicate improvements that will save money.

To prove the above statements, Walter N. Polakov has presented, in this and the preceding number of MANAGEMENT AND ADMINISTRATION, an outline of the work done by two firms in finding out what their power cost them and how these costs should be apportioned in the one case to service and in the other case to product.

It is necessary to spend money in order to save more money. In the present instance the firms in question bought steam flow meters and installed them permanently on the branch steam lines. The records taken showed at once where steam was going, and charges from then on were made directly to the operations involved. To the manager who is anxious to apportion all costs correctly to product, so that his selling prices may be based on actual facts rather than guesses, the advantages of this arrangement are obvious.

Generally, regular processing is the most economical manufacturing procedure, and foremen who were running their departments erratically, were induced to cooperate and smooth out their power demand curves, as the charts on page 556 show. Moreover, the sources of many unsuspected "power leaks" were discovered. In one year the Mount Hope Finishing Company saved in steam generation $39,760, in distribution $12,320, in utilization $24,800, or a total of $76,880. This amount is a comfortable sum to tuck away in profits.

The means necessary to introduce and operate such a system are simple and are clearly explained in the articles. The cost of equipment to be installed is comparatively small. The benefits to be derived are well worth the effort and expense. Practice, not theory, forms the basis for these claims, and the facts should encourage every manufacturer to see if he cannot duplicate the records in his own power plant.

A New Field for Investigation

MUCH work has been done toward putting selection and placement of workers on a scientific basis. With rare exceptions, all psychologists who have directed their efforts toward the solution of manufacturing problems have concentrated their studies on the employment office. Merchandizing methods have been the subject of many psychological investigations but in the productive departments the doors from the employment office to the factory have acted as effective barriers to all persons interested in the study of the activities and capacities of the human mind.

This concentration of effort on a single phase of employee activity has not been without beneficial results. It is doubtful whether, under conditions leading students and investigators to spread their work over wider fields, we should have acquired, in so short a time after the inception of the studies, such authentic and authoritative data upon which to base employment and placement methods as is now available. The concerted efforts of industrial psychologists toward the solution of this problem have given employers a body of information which, though by no means complete, permits much more accurate and scientific selection of workers than was possible a few years ago.

But these studies apply only to new employees. What of those already a part of the organization, and what of the new workers after they have lost their identity in the main body of employees? What is being done to enlist the real effort of these men in furthering their employer's aims? What is being done to train the foremen, to whom the workmen must look for guidance and leadership?

Something has been done along each of these lines but if well done it has been largely by chance. There is need of detailed study of the reactions of workers to their working conditions, to their wages, to plant social and athletic activities, to participation in management functions, and similar subjects which influence the worker's mental attitude toward his job.

Many concerns have taken definite steps toward obtaining a contented working force, able and willing to give the employer its best efforts, but few, if any, such actions have been based on knowledge of just what the workers wanted or required to fully develop their potential value to the company.

This is a broad field and a very important one in securing complete industrial harmony. It appears to be a problem that can be solved accurately only by the application of psychological principles. It is, possibly, the next problem that should be attacked by students of psychology.

INDUSTRIAL EQUIPMENT
NEWS FOR THE MANAGEMENT

This department is conducted to give our readers essential facts regarding items of industrial equipment recently placed on the market, that may be used to increase production or lower costs. The editors will be glad to furnish additional information about any item. All information given is obtained from reputable manufacturers, and MANAGEMENT AND ADMINISTRATION accepts it as reliable.

Electric Tiering Machine

A LIGHT duty, worm drive, tiering machine for use in piling or unpiling material of many kinds, or as an elevated platform from which shafting can be hung or oiled, or similar work performed above the floor, is being manufactured by Lewis-Shepard Company.

The ½ hp. motor is operated from any lighting circuit and makes possible

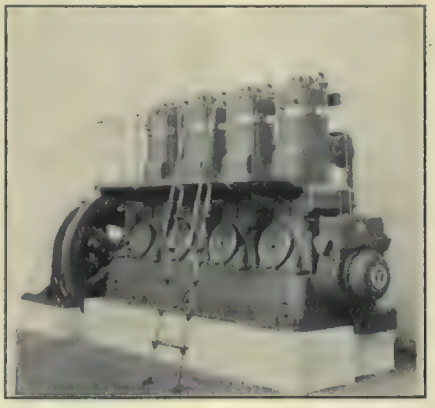
ELECTRIC TIERING MACHINE

a lifting speed of from 9 ft. per min. for 1000 lb. capacity stackers to 14 ft. per min. for 500 lb. machines. A "dead man" type controller is used, and there are upper and lower limit stops.

The lifting and steering handle lifts the front feet of the stacker from the floor when it is to be moved. The hinge lock is automatic, so that when the top section is elevated it is locked.

Diesel Engine

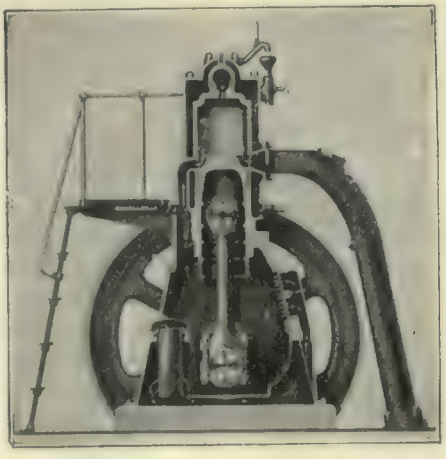
IN the style VA, Type Y oil engine, Fairbanks-Morse and Company has developed an engine for general power purposes that has several advantages over their previous models.



DIESEL ENGINE

Two-cycle principle with solid injection of fuel has been retained, but operating compression has been increased to 500 lb., so that increased heat fires the fuel without the aid of a torch when starting. Starting is accomplished by means of compressed air, stored in steel tanks by an auxiliary power compressor. Lubricating system is entirely automatic, a pump forcing oil to all moving parts. All piping has been eliminated or enclosed. Control has been simplified.

Reliability with low maintenance costs, maximum accessibility and easy operation has been considered in the new design. Measures toward greater fuel economy have resulted in an engine which, under test, consumed 0.42 lb. of 18,000 B.t.u fuel oil per brake horsepower at full rated load. Fuel consumption curve is practically a straight line on ratings varying from 75 to 100 per cent load.



DIESEL ENGINE—INSIDE VIEW

Standardized Chain Drives

AN announcement by Link-Belt Company states that they have standardized their silent chain drive to such an extent that drives from ¼ to 10 hp. in practically any reduction from one

SILENT CHAIN DRIVE

to one to seven to one are now carried in stock for immediate delivery.

The stock drive chains are of the same quality standard as those built for special application. The bushed joint construction shown in the illustration is like that used in all Link-Belt silent chains.

DC Motors

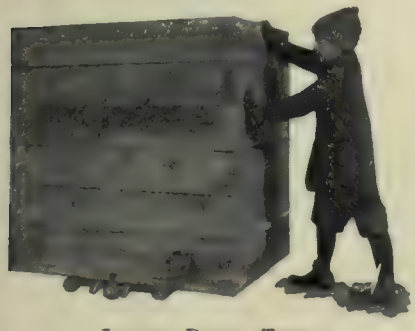
A NEW line of direct current motors, being manufactured by the General Electric Company, includes all standard horsepower ratings and all speeds from slow speed blower motors to high speed motors for driving pumps. This new line includes both constant and adjustable speed motors and supersedes several old styles for general service.

NEW DIRECT CURRENT MOTOR

Bi-polar types are called BD, and four pole motors CD. They range from ½ to 200 hp., with speeds of 850, 1150, and 1750 r.p.m. Standard G. E. steel shell babbitted bearing linings are used, and BD motors have riveted frame construction. Some of the smaller motors are mechanically interchangeable, with units of a redesigned type of AC motors.

Dolly Truck

A LIGHT-WEIGHT sturdy truck upon which any crate, box, cask, barrel, or roll can be slid or rolled and easily moved, is being made by Marion Tool Works, Inc. Projecting skids slope



LOADED DOLLY TRUCK

down to within two inches of the floor, so that heavy articles can be loaded or removed easily. The wheels lock sideways so that the truck will not creep away during loading.

The frame is slanted inwards so that

TRUCK WITH BARREL

curved loads, like barrels, are held securely. Wheels on center axle are slightly larger than others to act as a pivot for easy operation. Axles are

DOLLY TRUCK

heavy steel; tool steel roller bearings are used in wheels. Two sizes are available: 24 in. by 17 in. by 3 in. high, weighing 51 lb., and 30 in. by 21 in. by 3 in. high, weighing 61 lb.

Coal Pulverizer for Direct Firing

THE Bonnot unit air ball mill is a machine for pulverizing coal as it is required for furnace operation, thus eliminating storage of the pulverized product. Advantages claimed for it are: dependably continuous operation; low maintenance costs; flexibility to assure control of wide load variations; constant fineness of finished product; cleanliness; and strong construction.

The ball mill principle is used. Coal from bunkers is fed into the mill by a slow speed, disc-type feeder which is adjustable to meet load demands, adjustments being made manually or automatically. The pulverizing cylinder is made of grey iron lined with rolled steel bars. It revolves at about 30 r.p.m. on four rollers mounted on Timken roller bearings. A perforated steel pipe extends into the cylinder, which collects by suction all finished product as soon as it is pulverized and delivers it to the air separator. Here a current of clean air picks up the fuel and delivers it to the exhauster, whence it is delivered to the furnace.

Fineness of pulverization is controlled by adjustment of clean air inlet to the perforated pipe. Tramp iron or other foreign material will not cause stoppage or breakdown but, instead, serves as an additional grinding medium. The entire unit, except exhauster, is mounted on a grey iron bed plate. Lubrication is with Alemite system. Power consumption varies from 13-16 hp. per ton, grinding Pocahontas coal to 17-20 hp. per ton, grinding Pittsburgh or Ohio coals when moisture content does not exceed 5 per cent. Capacities range from 3000 to 16,000 lb. per hr. It is made by the Bonnot Company.

Worm Gear Speed Reducer

A SPEED reduction unit for general service that is simple in construction, compact, quiet in operation, and has a long life is the Type GUW-D developed by Boston Gear Works. It is

WORM GEAR SPEED REDUCER

built for mounting on a base with General Electric motors. Component parts are interchangeable. Driven shafts project on either side of the case. These units are available in all standard horsepowers and speed ratios.

Crawling Tractor Crane

A NEW crawling tractor crane which can be used in many industries and for many purposes, such as reclaiming coal from storage, excavating, breaking up scrap, etc., is being marketed by Industrial Works. It can be operated with clam shell or drag line bucket, electro-magnet, hook and block, or grapple; it is readily converted into a shovel or pile driver, and can use any equipment that operates on a boom.

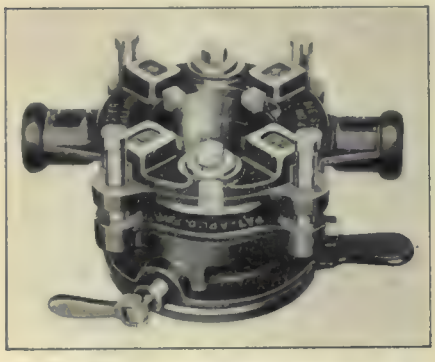
CRAWLING TRACTOR CRANE

Some new features are: split gears by means of which each tractor belt can be controlled separately so as to make maneuvering in close quarters easy; speed increased 25 per cent over former models; double clutch mechanism by which the two slewing band clutches are operated by a single lever; long tractor belts to give stability when lifting over either end, or any kind of ground—center distance between the two end sprockets is 10 ft.; all operations of the equipment are independently controlled.

Steam engine, electric motor, gasoline motor, or Diesel type oil engine can be used to furnish power for operation.

Die Stock

AN easy cutting, receding die stock for use in threading pipe is being marketed by The Oster Manufacturing Company. It is well constructed of high-grade material; new type dies with correct cutting angle or rake make operation easy. Die head can be adjusted



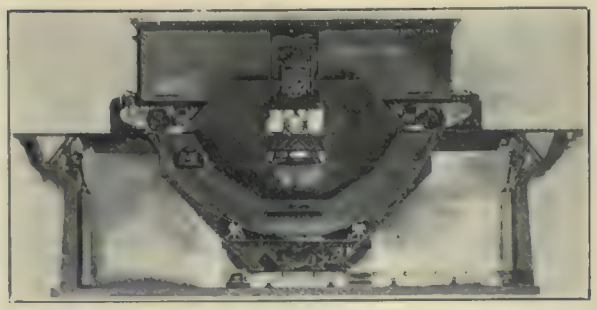
DIE STOCK FOR THREADING PIPE

to cut over- or undersized threads as well as standard. A self-centering chuck is standard equipment, but bushings and set screws can be supplied. Capacity is 1 to 2 in. pipe, and both plain and ratchet types are made.

Box-Car Unloader

A NEW type of box car unloader suitable for emptying box cars of grain, coal, or similar bulk material, into a pit from which the contents are taken by mechanical conveyors to storage, has been developed by Link-Belt Company.

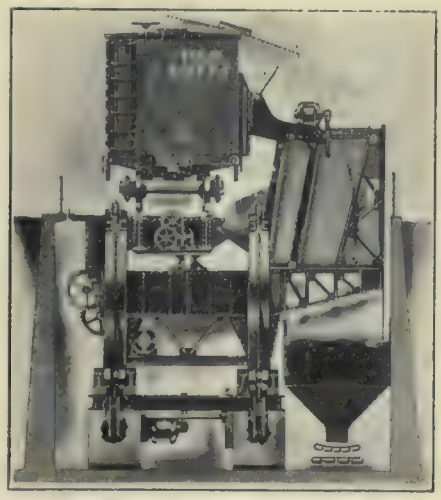
It consists of a car supporting platform composed of two heavy girders connected by diaphragms and bracing, pivotally connected with a structural steel cradle. The loaded car is spotted on the unloader, disappearing end clamp



BOX CAR UNLOADER—SIDE VIEW

carriages are brought into position, and, at the same time, the end posts, which support the weight of locomotives or cars when passing on or off the dumper, are removed.

The car is then tipped sideways 15 degrees by means of two cast-steel gear rack sections driven by a 20-hp. motor equipped with a solenoid brake. Then the car is tipped endwise 40 degrees in each direction, completely emptying it. Endwise tipping is obtained through steel cables operated by a 40-hp. motor, solenoid brake equipped, rolling the



BOX CAR UNLOADER—END VIEW

cradle consisting of two semi-circular girders, braced and diaphragmed, on four rollers.

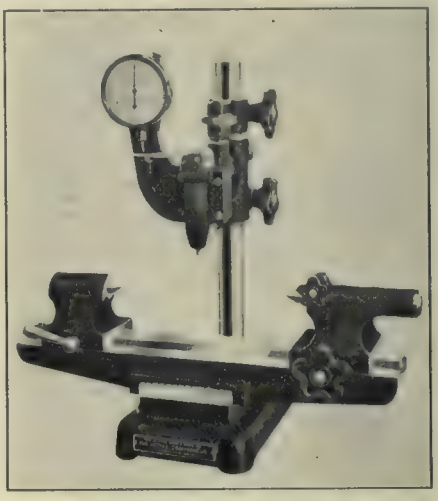
After the car is emptied it is returned to normal position and moved off the platform. The complete cycle of operation of the unloader occupies 3½ min.

With a proper car spotting system and ample facilities for removing material from the receiving hoppers, an installation of two unloaders should maintain an average capacity of 16 cars per hour.

Precision Checking Gage

THE Active Comparator is a device for making quick comparison of the dimensions of a wide range of machine work with those of standard pieces for the purpose of inspection after work has been done or for checking accuracy of work in progress. In use, the dial is set to zero on a standard piece. Pieces to be checked are passed under the contact point, and the dial registers variations plus or minus from standard.

The dial reads to 0.0001 in., but since these graduations are ¼ in. apart, it is practicable to obtain much closer readings. The accompanying illustration shows the Comparator equipped with an attachment for testing the diameter and



PRECISION CHECKING GAGE

concentricity of pieces held on centers. Flat or round pieces are tested on the plate, over which the center attachment is mounted. Cylindrical pieces may be tested for diameter and concentricity by the use of a V-block. Other uses will suggest themselves to experienced mechanics.

The instrument is well made and contains few moving parts. Contact points are of heat-treated hardened steel, ground and lapped. It is made by The Active Machine and Tool Company.

Low Pressure Welding Torch

A LOW pressure torch which can be used for cutting as well as for welding by an interchange of tips has been developed by The Alexander Milburn Company. It will operate on high pressure or low pressure gas with equal efficiency, and is especially designed to operate with low pressure acetylene gas, city gas, or hydrogen.

The torch is constructed of bronze forgings and seamless steel tubings. It uses the standardized parts of other Milburn welding and cutting torches. Tips are made of solid copper.

Production Counters

FOR installations where it is desirable to locate production counters in a central place some distance from the machine on which the count is to be taken, or where articles counted are

PRODUCTION COUNTER

very small or thin, or light in weight, making it difficult to count by mechanical means, The Veeder Manufacturing Company has developed the Form U magnetic counter.

These counters are operated by electro magnets and will work satisfactorily only with direct current. Dry cells, storage battery or generated current of proper voltage can be used. Maximum recommended counting speed is about 600 per min.

Portable Electric Welder

AN electric welding equipment which may be moved anywhere in the factory or yard, and carries its own power plant for making welds, is being marketed by Lincoln Electric Company. The outfit consists of a standard Fordson tractor combined with a specially designed trailer to carry the welding equipment.

PORTABLE ELECTRIC WELDER

The Fordson tractor is capable of pulling the outfit anywhere work is to be done, and can maintain a speed of 15 to 18 miles per hr. on pavement. When the job is reached, the tractor furnishes power to drive the welding generator so that the benefits of electric welding can be obtained in places where electric current is not ordinarily available. The trailer has space to carry all accessories needed for a job, such as cable reel, air compressor and tanks, tool box, etc.

Electric Calculating Machine

AN electrically driven, automatic calculating machine for multiplying, dividing, adding, subtracting, and combinations of these, is being manufactured by Marchant Calculating Machine Company. Automatic operation enables calculations to be made with a minimum amount of manipulation, thus

ELECTRIC CALCULATING MACHINE

speeding up work and reducing costs. For example, to multiply a number by 9, the number is set up on the machine, the multiplier key and the key marked 9 are pressed, and the machine, operating at over 300 r.p.m., develops the correct answer in the carriage dial.

It is claimed that this device requires only one-third the number of operations, and half the time that was necessary with the former methods of producing results by "shortcuts." The machine is strongly built and contains but six component units. All castings are die made. A built-in Westinghouse 1/20 hp. motor furnishes power for operation. The machine is finished in black enamel and nickel plate. Each part of each unit is standardized and interchangeable.

Electric Capstan Car Puller

AN electric capstan car puller for use by industrial plants in moving freight cars about yards is being marketed by Clyde Iron Works Sales Company.

A vertical winch or capstan head is bolted to a bevel gear driven by an electric motor through two sets of intermediate gearing and a bevel pinion. All parts are enclosed in a semi-steel housing which is dust- and weatherproof. All gears are steel, except the semi-steel intermediate gear and the bakelite micarta motor pinion. They all run in an oil bath. Alemite lubrication is used. Operation is controlled by push button arranged for foot control. Overload and low voltage protection are provided.

Capacities are line pulls of 3000 lb., 6000 lb., and 10,000 lb., at approximate speed of 40 ft. per min. Motors used are 5 hp., 10 hp. and 15 hp., respectively.

Catalogs

THE Goodyear Tire and Rubber Company has just published a 164-page book called "Handbook of Goodyear Mechanical Rubber Goods." It contains illustrated descriptions of their complete lines of mechanical goods, including belting of all kinds, hose, and packing.

"Full Safety Motor Starters" is an illustrated booklet published by Westinghouse Electric and Manufacturing Company outlining advantages of using safe motor starters, and describing the Westinghouse line.

A 56-page illustrated booklet has been issued by Republic Flow Meters Company concerning pyrometers. Applications and descriptions of the Republic line are given in detail.

The Barrett Company has published the first of a series of reference books about built-up roof construction. Vol. 1 deals with flat roofs and gives Barrett specifications for roofing board roof decks, poured concrete, precast concrete slab, poured gypsum, precast gypsum slab, and book tile roof decks. Drawings illustrate methods of application.

Catalog No. 46, issued by Boston Gear Works Sales Company, contains specifications and descriptions of their complete line of "standardized gears." The book is pocket size and contains 192 pp.

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 100 magazines; it also includes the publication of some 50 book publishers and professional societies as far as these are of managerial interest to industrial executives. The decimal number at the right of each item is the index number according to the Dewey Decimal Classification System and indicates the place the article or book will take when filed in accordance therewith in the classified subject scheme. If articles are grouped according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. Photostat copies of any magazine article indexed will be supplied by The Ronald Press Company within a year following the date of publication at a price of 25 cents the page. When ordering photostats please identify the article by quoting from the index: (1) Title of article; (2) Index number; (3) Name, date, and page number of periodical in which the item appears. A remittance of 25 cents a page should accompany the order. The books and pamphlets indexed can be procured from The Ronald Press Company or from their respective publishers.

Industrial Buildings and Plant Maintenance

Buildings and Equipment

Causes of Surface Checks in Wood in Varnish-Drying Rooms. 621.74
Harry D. Tiemann. *Journal of the Society of Automotive Engineers,* May 1925, pp. 523-527. Discussion of a paper in the November 1924 issue, dealing with the properties of wood and its action under production, especially with regard to moisture content and the action of preservatives.

Central of Georgia Coach Shops Have Efficient Layout. 658.23
Railway Age, April 11, 1925, pp. 923-928. Illus. Description of new plant designed for repair and maintenance of rolling equipment.

Characteristics of Industrial Floors. 658.22
H. K. Ferguson and B. R. Magee. *Iron Age,* April 16, 1925, pp. 1127, 1169-1170. Factors to be considered in selecting a floor, considering both the structural floor and its wearing surface. Methods of preventing injury, abrasion and decay with notes on various kinds of floor. The matter of adaptability to loads and machine weights is also discussed.

Concrete Block and Brick Compared. 658.22
Buildings, April 24, 1925, pp. 886-887. Tables of comparative costs in different localities for laying concrete block and clay brick masonry.

The Cooling and Conditioning of Air. 658.25
H. J. Macintire. *Chemical and Metallurgical Engineering,* April 1925, pp. 437-442. Illus. Development of a method of calculating the refrigeration required by an air conditioning system of the spray type.

Economic Factors of the Office Building Project—II. 658.2
Leo J. Sheridan. *Buildings,* April 24, 1925, pp. 869-876. Illus. Quality of materials, mechanical equipment, utilization of space, investment and income, etc.

Factors in Industrial Organization. 658.234
Richard Wendorby. *Cassier's Industrial Management,* April 1925, pp. 257-259. Discussion of layout of small factories.

Fire Resisting Wallboard in Industrial Plants. 658.284
H. E. Jeddy. *Industrial Engineer,* May 1925, pp. 235-237, 258. Illus. Examples of uses in protecting frame construction, remodeling plants, constructing kilns, store rooms, etc.

Fuse Color Scheme That Prevents Misuse of Fuses. 658.58
Charles R. Hepner. *Industrial Engineer,* May 1925, pp. 228-229, 260. Illus. Methods that corrected troubles in the handling of fuses at the Peerless Motor Car Company and the Willard Storage Battery Company.

How Kaufmanns Reorganized Offices to Get More Work Done. 658.236
H. E. Prentke. *Store Operation,* April 1925, pp. 5-8. Illus. Systematic layout and proper equipment speed operations in store general office. Methods applicable to other offices.

Labor Saving in a Lime Plant Utilizing Waste Marble. 658.28
F. A. Westbrook. *Pit and Quarry,* April 15, 1925, pp. 47-56. Illus. Layout, material handling machinery, power equipment.

Modern Air Heating Plants for Large Localities. 658.25
Engineering Progress, March 1925, pp. 73-74. Illus. Steam-turbine driven device for localizing the heating of air.

Shop Ventilation as an Investment. 658.25
A. G. Anderson. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 531-534. Illus. Effects of good air and bad air on production. Economical methods of obtaining correct ventilation, natural or mechanical, by roof and window construction, and by air conditioning equipment.

Types of Building for the Print Shop. 658.23
Morgan C. Farrell. *The American Printer,* April 20, 1925, pp. 29-31. Details of construction with advantages and disadvantages of various types. Applicable to buildings other than print shops.

Unusual Phases of Power House Lighting. 658.24
A. F. Loewe. *Power Plant Engineering,* May 1, 1925, pp. 487-491. Illus. Modern method of lighting turbine and boiler rooms with emphasis placed on illumination of instruments and gages.

Maintenance and Repair

Be Fair to Your Scales. 658.58
C. R. Dutton. *Iron Trade Review,* April 23, 1925, pp. 1061-1062. Illus. Maintenance methods to preserve accuracy.

Increasing Income by Reducing Repair Costs. 658.516
H. Y. Carpenter. *Railway Mechanical Engineer,* April 1925, pp. 213-214. Standardization of parts and improvement in design will aid in keeping locomotives on the road.

New Process for Treating Wood. 658.58
A. M. Howald. *General Contracting,* April 17, 1925, pp. 819-822. Illus. Single process for impregnating timber with zinc chloride and petroleum oils with cost data.

Organizing for Plant Maintenance Work. Maintenance Practice at the Ford Plant. 658.58
L. A. Blackburn and E. E. Remington. *Journal of the Society of Automotive Engineers,* May 1925, pp. 527-533. Discussion of two papers in the November 1924 and January 1925 issues, dealing with the maintenance and safety methods of the Olds Motor Works and the Ford Motor Company, respectively.

The Prevention of Hot Boxes. 621.89
T. O. Quinn. *Railway Mechanical Engineer,* April 1925, pp. 217-218. Systematic records and analysis of causes cut down failures to one in 585,113 miles on one division.

General Management and Policy

Administration and Policy

Assets or Ashes After the Fire. 658.284
Raymond C. Willoughby. *The Nation's Business*, May 1925, pp. 45-46. Illus. It is as necessary to insure against the loss of valuable records as against the loss of buildings and equipment.

Better Products for Less Money by Standardization. 658.516
F. C. Brown. *Universal Engineer*, April 1925, pp. 24-26. Review of work done by Bureau of Standards with suggestion that manufacturers are not taking full advantage of facts established in the laboratory.

British Industry Moving Toward Simplification. 658.516
James F. Whiteford. *Industrial Management*, April 1925, pp. 193-196. Post war conditions force new attitude toward competition and quantity production, and open up opportunities for simplification.

Building Production Schedules from Sales, Costs and Profit Analyses. 658.5
G. Charter Harrison. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 461-464. Charts.

Capitalizing the Advantages of the Small Factory—I. 658
Dale S. Cole. *Industrial Management*, April 1925, pp. 208-212. Good management is vital. A study of sales prices and an effort to keep overhead costs down are required.

The Classification Problem in Statistics. 311
R. H. Coats. *International Labour Review*, April 1925, pp. 509-525. System of classifying industries and occupations, based on a tripartite classification of commodities, by component material, use or purpose, and origin.

Cutting Down the Waste Pile. 658.516
Ray M. Hudson. MANAGEMENT AND ADMINISTRATION, May 1925, pp. 413-416. An authoritative article by the chief of the Division of Simplified Practice, on the cost of waste elimination in industry and the benefits that may be derived therefrom.

Economic Efficiency of the Full-Automatic Turret Lathe In Comparison With the Semi-Turret Lathe. 658.27
R. J. Wadd. *Mechanical Engineering*, May 1925 (Sect. 2), pp. 411-414. Economic results arising from changes in machine-tool equipment at the Shepard Electric Crane and Hoist Company, as affected by the labor employed and the efficiency of production, are analyzed with the aid of the A.S.M.E. Materials Handling Division's Formulas.

Factory Fire Protection. 658.284
H. Edsil Barr. *American Machinist*, April 16, 1925, pp. 627-628. General information on methods and equipment for the protection of industrial plants against fires. Chemical fire extinguishers are recommended to supplement sprinkler systems, and emphasis is placed on the importance of teaching proper use and maintenance of all equipment.

Functionalizing a Business Organization. 658.16
Webster Robinson. *Harvard Business Review*, April 1925, pp. 321-338. Charts. A detailed study of the necessary steps in changing a business organization so that each function is recognized and placed under the direction and control of a properly qualified executive who has only one or few similar functions to perform.

Grinding Wheels Standardized. 658.516
Abrasive Industry, May 1925, pp. 134-140. Illus. Summary of report of Grinding Wheel Manufacturers Association of America and Canada, giving complete specifications for practical standards for all grinding wheel purposes.

Industrial Preparedness. 355.21
Dwight F. Davis. *American Machinist*, April 30, 1925, pp. 677-680. Brief outline of steps being taken to allocate manufacturing facilities of the United States for war purposes, and to guard against production losses in case of war. The author is Assistant Secretary of War, directly responsible for the development of industrial preparedness.

The Need for an Applied Psychology of Organization. 331:150
Henry S. Dennison. American Management Association, New York. Leaflet, 12 pp. Expresses the need for scientific study of the relationships among workers and employers for the purpose of eliminating conflict and formulating principles of human organization.

Promotion of Standards. 658.516
Ray M. Hudson. *Monthly Labor Review*, April 1925, pp. 18-21. Standards eliminate waste, and hence their use should be widely promoted, with frequent check-up as to extent of application.

Standardization of Grinding Wheel Shapes and Sizes. 658.516
Committee on Formulation of Acceptable Standards. *American Machinist*, April 30, 1925, pp. 689-693. Tables of shapes and sizes of grinding wheels developed by a committee of grinding wheel manufacturers of United States and Canada. The principle of simplification has been applied, and the number of shapes and sizes reduced to a minimum.

Standardize Grinding Wheels. 658.516
Iron Trade Review, April 30, 1925, pp. 1118-1119. Illus. Manufacturers Association prepares complete specifications and eliminates sizes, making possible a stock reduction of a half million wheels.

Standard Sheets for the Non-Ferrous Metals. 658.516
Engineering Progress, March 1925, pp. 63-64. Illus. Make-up and content briefly outlined.

Economics

American and Foreign Patents. 608
Edward H. Kettridge. *Manufacturers' News*, April 18, 1925, pp. 10-11, 20. Comparison of patent laws and their influence on American inventors and manufacturers.

The Economist as an Aid to Management. 658:31
L. D. H. Weld. American Management Association, New York. Leaflet. 12 pp. The part an economist or a statistician can play in management. Enumerates and briefly explains principle lines of work where their efforts may be of value. Discussion.

Foreign Flotations Should Back Up American Exporters. 381
O. B. Iles. *Iron Trade Review*, April 16, 1925, p. 1002. Loans should carry the provision that preference must be given to American products in making purchases of equipment which the loans are to finance.

Foreign Trade War Looms. 382
Julius Klein. *Michigan Manufacturer and Financial Record*, May 2, 1925, pp. 8, 25. America's position abroad secure because of high standards used.

The Influence of Cheap Power on Factory Location and on Farming. 658.217
Ernest S. Bradford. *The Annals of the American Academy*, March 1925, pp. 91-95. Illus.

Psychology in Business Relations. 150:658
A. J. Snow. A. W. Shaw Company, Chicago. 562 pp. Illus. $4.00. A readable book in which is discussed the application of the principles of psychology in the various activities of business. The purpose has been to give psychological principles and to show specifically how their application has contributed to more successful functioning of business enterprises. Generalities and technicalities of psychology have been omitted. The book is divided into five parts, which deal with the psychology of the consumer, psychology in marketing, in retail and wholesale selling, and in employment. Besides being a very interesting book, this volume should prove useful in interpreting business actions and directing them to a favorable result.

Selecting and Placing College Graduates in Business. 658
John Mills. American Management Association Bulletin, 1925, 27 pp. This paper leads to the conclusion that the failure of the college man to grow intellectually during the early years of business and the failure of business to provide facilities for such development are the main sources of failure in connection with the college man in business.

Taxation and Welfare. 336.2
Harvey Whitefield Peck. The Macmillan Company, New York. 269 pp. $2.50. An attempt at an impartial and scientific survey of the financial and social relations of the problem of taxation. As the author believes that the character of public expenditures deserves more attention than is usually paid to it in discussions of taxation, he first deals with the proper field of public expenditure and then with the distribution of the tax burden. The idea is presented that, where public money is spent wisely, a higher tax rate is possible than where money is wasted.

Management

Change in Design Cuts Costs and Revives Waning Demand. 658.516
H. R. Simonds. *Iron Trade Review*, April 30, 1925, pp. 1117, 1124-1125. Illus. The Hergi Manufacturing Company take over the making of floor lamps, and, by simplifying and standardizing design, and shipping product knocked down, reduce selling prices and build up a capacity business.

$15,000,000 Saved by Ford Plants. 658.5671
George E. Hagemann. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 557-560. Illus. Methods of waste reclamation which operate on a production basis and net this vast sum annually. Beneficial effects on the personnel engaged in the work.

Following Up Purchase Orders. 658.75
Iron Age, May 7, 1925, p. 1339. Methods of the International Petroleum Company of getting goods after purchasing order has been received by supplier. A feature is the follow-up system, listing 23 pertinent questions.

Getting the Most Out of Your Machine Tool Dollar. 658.27
Robert F. Runge. *American Machinist*, May 7, 1925, pp. 719-722. Simple formulas to show when savings can be made and when not by the installation of new machine tools. The author insists that if savings can be made it is the responsibility of management to take advantage of them.

How Pepsodent Gets Peace and Harmony in Its Family. 658.16
R. E. Spline. *Printers' Ink*, April 9, 1925, pp. 17-20. Description of plan which helps toward co-operation among all departments.

An Idea That Added Thousands to Profits in 24 Months. 658
William Cooper Procter. *System*, May 1925, pp. 597-601, 656, 658, 660-661. Illus. Adopting a plan of uniform production over a 48-week year of guaranteed work to employees, cuts costs, reduces inventories, improves morale of employees, increases output, and adds to profits in the Proctor and Gamble plants.

John Edson Sweet. 92
Albert W. Smith. The American Society of Mechanical Engineers. 220 pp. $3.75. An engineer rich in human attributes is the outstanding impression made by reading of the life of John Edson Sweet, as presented in his biography. His technical achievements "in machine design and . . . pioneer work in applying sound engineering principles to the construction and development of the high-speed engine" are not dimmed but rather thrown into sharper definition by his "wonderful gift for making friends and holding them."

Professor Sweet influenced machinery building possibly to a greater extent than any of his contemporaries, through the teaching patiently imparted to his students, through counsel and advice given freely to his friends, and through the originality of his inventions and designs. He also influenced the lives and characters of those who came in contact with him. Possibly the latter is the greatest of his contributions.

Such is the summation of the story of his life as written by his friend, Dean Albert W. Smith.

The book is divided into two parts. The first is the narrative of his life interwoven with reference to more important phases of his work and achievements. The second is made up of addresses and letters, for Professor Sweet was unlike many engineers in that he wrote freely for publication. A short appendix gives details of some of his more important inventions and designs.

To every engineer and industrial manager there is true inspiration in this account of a worth-while life honestly lived; there is encouragement in the record of achievements; there is a vital lesson in the portrayal of a perfect union of technical abilities and human qualities.

Labor-Saving Equipment in Road Construction. 658.28
E. H. Lichtenberg and James A. Shepard. *Mechanical Engineering*, May 1925 (Sect. 2), pp. 414-415. Description and economic analysis of a new paver, employing the A. S. M. E. Material Handling Division's formulas for computing the economies of labor-saving equipment.

Management's Attack on Waste. 658
Gerard Swope. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 511-512. The responsibility of management in the elimination of waste and minimization of industrial controversy and how it can be met.

Pennsylvania Follows Broad Plan in Stores Department. 658.785
C. D. Young. *Railway Age*, April 18, 1925, pp. 977-980. Organization, its responsibilities, its methods and the results attained.

Pit and Quarry Handbook—1925. 621
Complete Service Publishing Company, Chicago. 456 pp. The first 312 pages contain condensed items of information on subjects such as various kinds of building materials, power plant operation, cost accounting, insurance, speed reducers, production statistics, shipping data, etc. The latter portion of the book is devoted to classified advertisements of manufacturers of various types of equipment, principally those used by contractors and builders.

Policy of a Shoe Manufacturer With Regard to Special Orders. 658.5
Harvard Business Review, April 1925, pp. 348-356. Production and marketing aspects of policy which permits orders to be taken for special shapes and sizes that cannot be filled on a production basis.

Simplified Control Methods in Manufacturing. 658.5
Mechanical Engineering, May 1925, pp. 334-338. Discussion of paper by R. E. Flanders. Simplified system of management dealing with the design, manufacture, and production control of a standard machine.

Some Toolroom Economies. 658.563
George C. Reilley. *American Machinist*, April 16, 1925, pp. 601-604. Practice and experience of the General Electric Company, Schenectady, in standardizing the shapes of cutting tools and rendering them easy to recognize. Information is also given on the care and handling of belts and slings.

Southern Furniture Plants Apply Modern Management with Success. 658
Charles F. Scribner. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 521-524. Charts. Fundamentals of modern scientific management as applied to small furniture manufacturing concerns.

Power Generation and Transmission

Fuel

Bituminous Coal—A Raw Fuel or a Chemical Resource. 662.6
Judson C. Dickerman. *The Annals of the American Academy*, March 1925, pp. 128-132. Discussion of the advantages of making use of all the elements stored in bituminous coal instead of only its heat units.

Clean Oil Improves Diesel Operation. 658.261
Power Plant Engineering, May 1, 1925, pp. 484-486. Illus. Centrifugal treatment of oil to remove solid matter and water gives improved operation of Diesel engines during test.

Drying of Coal for Pulverizing. 621.18
H. W. Brooks. *Power Plant Engineering*, April 15, 1925, pp. 422-423. Illus. Points to be considered when deciding whether or not to use driers.

Exploding B.T.U. and Cost-Per-Ton Theories. 621.18
I. O. Hughes. *Steam Power*, April 1925, pp. 5, 10. Some examples of what the use of proper coal means in cost of boiler room operation.

Fuel and Power Costs. 621.18
Francis Juraschek. *Industrial Management*, April 1925, pp. 225-231. Illus. Selecting the right coal for low steam costs.

Fundamentals of Fuel Economy. 658.26
Charles Longenecker. *Pit and Quarry*, April 15, 1925, pp. 69-71. Information necessary, organization essentials, and operating suggestions.

Proper Sampling of Coal Is Essential. 621.18
C. B. Murray. *Steam Coal Buyer*, April 1925, p. 19.

Use of Liquid and Gaseous Fuels. 621.18
Power Plant Engineering, April 1, 1925, pp. 384-386. Illus. Part of report of N. E. L. A. Prime Movers Committee.

Power Equipment

Designing a 500 Horsepower Steam Power Plant—VI. 621.101
Charles L. Hubbard. *Southern Engineer*, April 1925, pp. 56-61. Illus. Boiler furnaces, stokers, forced and induced draft, size of fans, and air volume and pressure.

Keeping Boilers Permanently Free from Scale. 621.18
Walter J. Hughes. *Gas Age-Record*, May 2, 1925, pp. 637-640. Method of softening water by the base-exchange system described.

The Mercury Boiler in the Industrial Heating Field. 621.1
H. R. Parker and J. F. Wait. *Industrial Gas*, April 1925, pp. 15-16, 26, 28-29. Illus. Applications and advantages of this type of equipment when using gas as fuel.

Relation of Boiler Equipment to Coal Buying. 621.18
Douglas Henderson. *Power Plant Engineering*, May 1, 1925, pp. 473-475. Before equipment can be selected properly, the character of coal available must be known as well as the demand to be placed on the boilers.

Power Plant Operation

Allocating Power Costs to Product. 658.26
Walter N. Polakov. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 553-556. Illus. Studies made at the Mt. Hope Finishing Company's plant to apportion power costs correctly to product, and economies in power generation resulting.

Analysis of Power-Plant Performance Based on the Second Law of Thermodynamics. 658.26
William L. DeBauffre. *Mechanical Engineering*, May 1925, pp. 426-428. Details of a step-by-step method of analyzing power plant performance, that shows the losses of available energy occurring in each stage of the process.

Converting Smoke Into Dollars. 658.261
Joseph Harrington. *Manufacturers' News*, April 18, 1925, pp. 5-6. Illus. Reasons for smoking factory chimneys, what they mean in increased fuel cost; and how to eliminate them.

Fitting Evaporators to the Heat Balance. 658.261
Robert D. Spear. *Power Plant Engineering*, May 1, 1925, pp. 480-481. Some methods for heating feed water economically.

How We Reduce Our Power Costs. 658.26
Industrial Management, April 1925, pp. 215-217. Five cases in which savings were brought about.

Operating Plan Cuts Industrial Steam Loss. 658.26
Henry Morgan Burke. *Power Plant Engineering*, April 15, 1925, pp. 424-427. Illus. Recording instruments, power dispatching, and bonus system for steam saving make it possible to have accurate plant records, to trace power losses, to revise operating practices, and to secure co-operation in the Mt. Hope Finishing Company's plant.

Reducing Costs in the Boiler House. 658.261
C. H. S. Tupholme. *World Power*, April 1925, pp. 214-217. Method of handling fixed costs, and practical suggestions on how to reduce operating costs and keep equipment in repair with minimum expense.

Some Common Mistakes in Operating a Stoker-Fired Boiler. 658.26
J. F. Barkley. *Universal Engineer*, April 1925, pp. 32-33. From experiences of Bureau of Mines, Department of Interior.

Power Transmission

Individual Motors and Silent Chains. 658.262
Dean W. Taylor. *Industrial Engineer*, May 1925, pp. 214-218. Illus. How the Red Wing Sewer Pipe Company was modernized by the application of individual motor drive through silent chain to all of the equipment.

Standardization of Textile Mill Lubrication. 621.89
Allen F. Brewer. *Textile World*, April 4, 1925, pp. 143, 145, 147-148. Description and application of various types of lubricating devices that are adaptable for use on textile machinery.

Summary of Research on the Application of Leather Belting. 658.2621
R. F. Jones. *National Engineer*, April 1925, pp. 176-178. Charts. Results of studies made by Leather Belting Exchange.

Marketing and Distribution

Advertising

How a Small Advertiser Prepared for Bigger Markets. 659.13
Albert E. Haase. *Printers' Ink Monthly*, May 1925, pp. 26-27, 115-116. Illus. The eight steps in the advertising growth of the Brandes Corporation.

How Elgin Watch Discovered Copy Experts Among Users. 659.1
Printers' Ink, April 9, 1925, pp. 73-74, 76, 80. The adoption of testimonials as the basis for a new type of advertising campaign.

How Much Attention Must Industrial Advertisers Give the Jobber? 659.13
Reginald Perry. *Printers' Ink Monthly*, May 1925, pp. 43-44. Experience of Chas. A. Schieren Company in getting the wholesalers' support.

How to Advertise Industrial Equipment Abroad. 659.13:382
E. W. Clark. *Advertising and Selling Fortnightly*, May 6, 1925, pp. 23-24, 66-67. Illus. From the experiences of the Sullivan Machinery Company.

How Twenty-Four Big Advertisers Determine Newspaper Appropriations. 659.131
Albert E. Haase. *Printers' Ink*, May 7, 1925, pp. 3-4, 6, 154, 157-158, 160, 163, 164.

How We Are Preparing the Ground for Future Advertising. 659.1
C. B. Dicks. *Sales Management*, April 4, 1925, pp. 551-552, 554. The La Valliere Company has not advertised extensively, but all plans and policies are made with the idea that it may be necessary later.

A Little Light on Dark Pictorial Subjects. 659.13
W. Livingston Larned. *Printers' Ink*, April 16, 1925, pp. 77-78, 80. Illus. Practical suggestions for obtaining new effects in copy illustrations by considering lighting effects.

No Need for Stiffness When a Line Is Pictured. 659.1
W. Livingston Larned. *Printers' Ink*, April 30, 1925, pp. 53-54, 56. Illus. Some ways for instilling human interest in advertising illustrations.

Publicity. 659.1
Ivy L. Lee. Industries Publishing Company, New York. 64 pp. $1.50. Two addresses, and questions presented to Mr. Lee by his audiences, with his replies. Among the subjects discussed are: What is the difference between news and advertising? What is publicity? What is propaganda—proper and improper?

Speaking Up for Your Customers. 659.1
James H. Collins. *Printers' Ink*, April 9, 1925, pp. 3-4, 6, 185-186, 189-190. Using the exploits or achievements of customers as a basis for copy often proves to be profitable advertising practice.

Selling

Build Sales by Improving Layout of Selling Territories. 658.808
G. E. Bittner. *Iron Trade Review*, April 9, 1925, pp. 938-940, 943. Illus. Suggestions on the most effective layout of salesmen's territories throughout the United States.

Building Sales Morale. 658.807
C. K. Woodbridge. *Gas Industry*, April 1925, pp. 144-147. Suggestions for obtaining a happy and effective sales force.

Building Sales on Known Facts. 658.85
Loren Emery. *Manufacturers' News*, April 18, 1925, pp. 8-9, 30. Review of information necessary to direct sales effort effectively, with special reference to markets in Cuba.

Collecting Money by Mail—I. 658.88
L. C. Lockley and S. B. Hoffman. *Advertising and Selling Fortnightly*, April 22, 1925, pp. 18, 68, 70, 72. A summary of methods being used by credit and collection men. Compiled from material assembled by Better Letters Association of Los Angeles.

A Credit Asset. 658.882
William Gregg. *Credit Monthly*, May 1925, pp. 16-17, 40-41. Illus. Protection of credit records from fire is not only important but may even prevent loss of credit standing by a company after a fire.

Credit Insurance, Pro and Con. 658.882
Eleanor Boykin. *Credit Monthly*, May 1925, pp. 15, 38. Opinions and experiences of several credit executives endorse insurance.

Credit Management. 658.882
Emery E. Olson and J. W. Hallman. The Ronald Press Company, New York. 444 pp. $4.50. A book which gives the details of credit mechanisms and practice in their relation to business organization and management. Largely because of the recent and rapid developments in the credit field, principles and practices of successful credit managers have not been available for the information of others. The present book is an attempt to remedy this condition by presenting material based on successful experience in credit work. Beginning with the social concept of credit, the work then discusses the relationship of credit to other business activities and functions, the relation of the credit department to the business unit, and the details of departmental operation. The book should be of value not only to credit men, present and future, but to all business executives who need thorough knowledge of the principles discussed to round out their business education.

Finding the Inside Track in Selling to the Textile Industry. 658.85
C. W. Hamilton. *Sales Management*, April 18, 1925, pp. 609, 631-633. Experiences of several well-known concerns in finding successful methods for selling to textile mills.

Getting the Bulge on Summer Sales. 658.82
System, May 1925, pp. 618-620, 652-653. Illus. Methods followed by various companies to increase summer sales.

Guessing Bees vs. Common Sense Facts in Setting Sales Quotas. 658.808
E. H. Toussaint. *Printers' Ink*, April 23, 1925, pp. 10, 12. Some suggestions for practical determination of sales quotas.

How Shall We Pay Our Salesmen? 658.846
System, May 1925, pp. 601-605. Comparison of various methods, and strength and weakness of different plans.

My Reply to Critics Who Say Marketing Can Never Be a Science. 658.8
Frederick A. Russell. *Printers' Ink*, April 23, 1925, pp. 105-106, 108, 112-113, 116. Review of progress already made in improving merchandising methods, with summary of additional steps—and how they can be taken—necessary to place marketing on a scientific basis.

New Letters to Collect Old Bills. 658.88
Electrical Record, May 1925, pp. 319-321. Illus. A series of five letters that have been successfully used in the collection of overdue accounts.

Not Essential to "Habla Espanol" to Sell in Mexico. 658.8:382
Ruel McDaniel. *Sales Management*, May 2, 1925, pp. 669-670. Suggestions for making Mexican merchandising campaigns effective.

The "Once Over" Salesman—A Recently Isolated Species. 658.801
H. D. Arthurs. *Printers' Ink*, April 30, 1925, pp. 41-42, 44. Suggestions for effective use of the salesman who is strong in new territory but cannot keep up the pace.

Problem of Distribution as Properly Solved by Co-operation. 658.8:334
W. M. Garrard. *Textile World*, April 18, 1925, pp. 81, 83, 85. Description of distribution methods used by Staple Cotton Co-operative Association, and how producers and consumers have benefited.

Profitable Export Market Analysis. 658.808
George F. Bauer. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 561-564. Illus. Data gathered in foreign countries by consuls and attaches of the diplomatic corps are analyzed and passed on to manufacturers engaged in the automotive industry by the Department of Commerce. The General Motors Export Company also conducts its own market investigations.

Researching the Researcher. 658.808
Harry R. Wellman. *The Nation's Business*, May 1925, pp. 23-25. Much of the present research work in solving distribution problems is unnecessary, uneconomical, and should be stopped: Advocates closer study of actual needs before spending money to gather statistics.

Sales Forecasting That Helps the Manufacturing Department. 658.808
Printers' Ink, May 7, 1925, pp. 41-42, 44, 48. A sales budget upon which the production department can rely makes possible many manufacturing economies.

Some of the Fundamentals in Sales Management. 658.85
B. J. Williams. *Advertising and Selling Fortnightly*, April 8, 1925, pp. 21, 52, 54, 56.

Striving to Satisfy New Customers. 658.85
Frank V. Faulhaber. *Packages*, April 1925, p. 33. Emphasizes necessity for giving orders of new customers extra attention in order that they be more than satisfied.

Testing the New Product's Sales Appeal. 658.808
Printers' Ink, April 23, 1925, pp. 49-50, 52. How Westinghouse discovered selling appeals and other marketing aids through a try-out sales campaign.

What About Your Christmas Selling Plans? 658.855
C. B. Larrabee. *Printers' Ink Monthly*, May 1925, pp. 19-21, 121-122. Illus. Suggestions for increasing seasonal salability by packing in attractive containers.

What to Avoid When You Start Out After Mexican Business. 658.85:382
Ruel McDaniel. *Sales Management*, April 4, 1925, pp. 517-518, 580. Experiences of Southern Equipment Company in cutting down selling and shipping expense.

Winning National Distribution for a "Local" Product. 658.821
E. J. Curtis. *Advertising and Selling Fortnightly*, May 6, 1925, pp. 15-16, 42, 44-46. Illus. Methods used by Curtis Companies, Inc., to obtain national distribution for Curtis woodwork.

Shipping

Better Shipping Containers. 658.78844
Floyd T. Smith. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 549-552. Illus. Various materials suitable for containers; advantages, disadvantages and applications for each.

Packing Automobiles for Export. 658.7884
Barrel and Box, April 1925, pp. 44-47. Illus. Summary of export packing methods that have delivered automobiles in good condition and pleased foreign customers and dealers.

Practical Details of Shipping. 658.788
H. M. Grasselt. *Candy Factory*, May 1925, pp. 33-34. Suggestions for securing more efficient packing, marking, and routing, and other items of shipping information.

Material Handling and Production Control

Material Control

Building and Starting the Tool Crib. 658.563
Anker L. Christensen. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 537-540. Illus. Layout of tool room and bins for most flexible, convenient and economical storage, and methods of bringing tools under control, based on practice at the Worthington Works.

A Reorganization Scheme With a Definite Objective. 658.235
Engineering Production, April 1925, pp. 116-117. Relocating material stores to reduce loss of productive time in obtaining materials.

Mechanical Handling

An Application of the Formulas for Computing Economies of Labor-Saving Equipment. 658.28
George Langford, Jr. *Mechanical Engineering*, May 1925 (Sect. 2), pp. 408-410. Application of the A. S. M. E. Materials Handling Divisions formulas for

computing the economies of labor-saving equipment is made to the purchase and operation of an electric industrial truck in place of hand lift trucks in the Belden Manufacturing Company.

Electric Telpher Lines. 621.86
P. Stephan. *Engineering Progress,* March 1925, pp. 53-57. Illus. Description of electrical, mechanical and operating features of various extensive German installations.

Formulas for Computing the Economies of Labor-Saving Equipment. 658.28
James A. Shepard and George E. Hagemann, *Mechanical Engineering,* May 1925 (Sect. 2), pp. 403-408. Five simple equations for determining the economies of labor-saving equipment; method of applying the formulas, correct assumption of bases, and the evaluation of the various factors.

Handling 168 Tons for Every Ton Produced. 658.281
Max Sklovsky. *Open Shop Review,* April 1925, pp. 153-161. Material handling is the major problem in managing a foundry with economy. Tables show weights of material and equipment involved in each operation.

A Modern Granary. 658.281
K. Wagner. *Engineering Progress,* March 1925, pp. 59-63. Illus. Handling methods compared between the bucket elevator plant at Trelleborg, Sweden, and the pneumatic plant at Kiel, Germany, with equipment and operating details of the latter.

Modern Material Handling Methods in the Cement Industry. 658.281
C. H. Sountag. *Pit and Quarry,* May 1, 1925, pp. 53-58. Discusses various methods and means for mechanically conveying raw materials of cement through first stages of production.

New Gravel Plant Challenges Common Practice. 658.281
E. S. Hanson. *Cement, Mill and Quarry,* April 20, 1925, pp. 7-8, 10, 12, 14, 16. Illus. Material handling methods and equipment at the plant of the Wilcox Company.

Observations of a Superintendent of Motor-Truck Fleet Operation. 656.124
J. F. Winchester. *Journal of the Society of Automotive Engineers,* May 1925, pp. 534-537. Discussion of a previously published paper dealing with the selection and upkeep of equipment.

Selecting Material Handling Methods for Economical Production. 658.281
Graham L. Montgomery. *Chemical and Metallurgical Engineering,* April 1925, pp. 427-431. Illus. How the Dunlop Tire and Rubber Corporation developed a mechanical handling system that gives highly satisfactory results.

Solving Problems of Vertical Transportation. 621.86
E. M. Bourton. *Canadian Machinery,* April 9, 1925, pp. 17-18. Illus. Types of equipment, advantages, adaptability of elevating machinery.

Ways in Which Sling Chains Are Abused. 621.86
David Fliegelman. *Industrial Engineer,* May 1925, pp. 223-227. Illus. Principles of chain loading which are often overlooked, with consequent danger of serious accidents.

Production Methods and Control

Analyzing the "How" of a Job. 658.5423
K. H. Condit. *American Machinist,* April 23, 1925, pp. 649-651. Illus. Analysis of an operation cycle into its elements or "therbligs." What therbligs are and how they are symbolized.

Autogenous Welding and Cutting as Practiced on the Atchison, Topeka, and Santa Fe Railway. 665.882
E. E. Chapman and H. H. Service. *Acetylene Journal,* April 1925, pp. 486-488, 492. Standard practices with numerous rules for obtaining best results.

Coining Press Operation. 658.5
A. R. Kelso. *Journal of the Society of Automotive Engineers,* May 1925, pp. 510-513. Discussion of a paper in the November 1924 issue, dealing with methods of increasing production of automobile parts, and resulting economies.

Effective Repair Part Schedules. 658.513
John H. Ames. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 525-526. Charts. Detailed outline of methods successfully used to schedule and control production of small orders for repair and replacement parts.

The Electrically Heated Soaking Pit. 658.561
T. F. Baily. *Forging—Stamping—Heat Treating,* April 1925, pp. 121-124. Illus. Advantages of electricity over gas at Donner Steel Company pits, with data on power and space requirements and comparative costs.

Electric Heating for Manufacturing Processes Assumes Importance. 621.3
C. L. Ipsen. *Iron Trade Review,* April 16, 1925, pp. 1008-1011. Illus. Successful applications of electric heat in manufacturing operations subsequent to the preparation of raw materials.

Gas Takes Charge of Heating in the Railroad Shop. 662.76
J. H. Gumz. *Gas Age-Record,* April 18, 1925, pp. 571-574. Illus. Availability for various processes, with cost data.

Installing Time Study Systems. 658.5421
A. Caddie. *Canadian Machinery,* April 23, 1925, pp. 13-16. Illus. First part of an article giving summary of how to organize a time-study department and place it in operation.

Installing Time Study Systems. 658.5421
A. Caddie. *Canadian Machinery,* April 30, 1925, pp. 16-17, 40-42. Continuation of article. Discusses actual taking of times.

Mechanical Aids to Motion Study. 658.5423
K. H. Condit. *American Machinist,* April 30, 1925, pp. 685-688. Description of photographic apparatus for motion study records, including the microchronometer for recording time, cyclegraphs, motion models, magsters and simultaneous motion cycle charts.

Reclamation of Car Journal Packing. 658.5671
G. Charles Hoey. *Railway Mechanical Engineer,* April 1925, pp. 219-221. Illus. Description of the system used on the Bessemer and Lake Erie for the conservation of oil and waste.

Some Elements of Drafting-Room Practice That May Be Standardized. 621.75
F. W. Ming. *Mechanical Engineering,* May 1925, pp. 346-348. Results of reply to questionnaires sent to 120 manufacturing firms as to the methods which they prefer in representing machine elements in drawings.

Welding vs. Riveting of Large Structures. 620.1
W. Spraragen. *The Iron Age,* April 9, 1925, pp. 1051, 1095-1096. Better product obtained at lower cost is possible when welding processes are used. Advantages and comparative costs.

Employment and Personnel Management

Employment and Training

Management Principles of Apprenticeship—II. 658.3861
H. A. Frommelt. *Industrial Management,* April 1925, pp. 206-207. Co-operation between plants is necessary to give prominence to the value of apprenticeship training.

Placing and Introducing Employees. 658.3115
Earl B. Morgan. American Management Association, New York. Leaflet. 10 pp. Report of Committee on Employment Methods, giving its views on placement as the fourth step in the major personnel activity of acquisition.

The Psychological Aspect of Job Analysis. 658.3115
Richard S. Uhrbrock. American Management Association, New York. Leaflet. 11 pp. Definition of job analysis, functions of wage and bonus plans, qualifications of the job analyst, psychological aspect of analysis, value of determining significant character traits. Discussion.

Training, Developing and Promoting Foremen. 658.386
Louis Ruthenburg. *American Machinist,* May 7, 1925, pp. 737,740. The author contends that it is entirely feasible to train foremen and outlines the text matter for a foremen's training course.

Personnel

Employee Lunchrooms. 658.3827
Louise Moore, Forrest W. Boswell, Burton R. Miller, H. L. Rhoades, R. A. Steelman. American Management Association, New York. Leaflet. 38 pp. Summary of the report of the Committee on Employee Service of the American Management Association. The findings are: (1) An employee lunchroom should be opened only if a definite need for a lunchroom exists; (2) the type of lunchroom should be suited to the needs of the particular organization; (3) the lunchroom is a distinct activity and it should stand or fall by itself; (4) the lunchroom is a business and has the same standards as any restaurant business; (5) a good manager is essential to success; (6) definite means of getting employees' co-operation in the lunchroom should be devised to advertise the lunchroom, to obtain suggestions, and to settle complaints; (7) most lunchrooms are run at a loss if overhead is considered.

Employe Representation—The Pennsylvania Railroad Plan. 658.3151
The Pennsylvania Railroad Company, Philadelphia. Booklet. 95 pp. Gives the history of the plan in operation at the present time, factors leading to its installation and how it operates. An appendix contains typical set of by-laws covering relations between management and employees.

Employes' Representation in Coal Mines. 658.3151:662.6
Ben M. Selekman and Mary Van Kleeck. Russell Sage Foundation, New York. 454 pp. $2. Report of one of a series of studies being conducted by the Foundation to learn and record "the experience of those industries in which definite effort has been made to give wage earners a voice in matters affecting their employment." It is a study of the Industrial Representation Plan in operation in the coal mines of the Colorado Fuel and Iron Company. History of employee representation, features of the plan adopted, its operation, its influence on trade union activities, and the authors' conclusions are all treated in considerable detail. Both good and bad features are found in the plan as constituted, and information concerning them will be of considerable value to executives operating or anticipating operation of similar plans.

Employes' Representation in Steel Works. 658.3151:669.1
Ben M. Selekman. Russell Sage Foundation, New York. 293 pp. $1.50. This is the report of one of a series of studies being carried on by the Foundation under the general title of "Wage earners' participation in management." The present volume is concerned with the Industrial Representation Plan in operation at the Minnequa Steel Works, a steel mill operated by the Colorado Fuel and Iron Company. The introduction of the plan, its essential features, its influence in securing the 8-hour day, in the determination of wages, and in adjusting grievances, and the reaction of both management and workers to it, are discussed with the idea of evaluating the services of such methods in securing better working relations between employers and employees.

Gaining the Workers' Confidence. 658.31
P. F. Walker. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 541-542. Plans adopted by several large manufacturing companies to get into satisfactory close touch with their workers.

House Organs Reducing Sales Resistance. Plant Publications Aid Good Will Spirit. 658.826
A. J. Hain. *Iron Trade Review*, April 16, 1925, pp. 998-1001. Illus. Characteristics and objectives of various kinds of publications, with examples from specific plants.

The Labour Department and Its Functions. 658.312
Eric N. Simons. *Mechanical World*, April 17, 1925, pp. 250-251. Suggestions for duties and responsibilities of a works personnel department.

Paving the Way for Trained Leadership. 658.386
J. K. Novins. *Industrial Management*, May 1925, pp. 302-305. The present status of foreman training.

Selecting the Salaried Employee—I. 658.3115
Eugene J. Benge. *Industrial Management*, May 1925, pp. 279-283. Illus. How the Atlantic Refining Company determines the qualifications of applicants.

Sharing Management With the Workers. 658.3151
Mary Van Kleeck. *The Journal of Social Forces*, March 1925, pp. 506-510. Summary of the organization and operation of the Partnership Plan being used by the Dutchess Bleachery, Inc.

Some Aspects of the Open Shop. 331.889
Paul Eliel. *Buildings*, April 24, 1925, pp. 863-865. Fundamentals, likenesses and differences of open and closed shop practice.

Teaching Economics Through the Employees' Publication. 658.3853
D. C. Vandercook. *Industrial Management*, May 1925, pp. 308-311. Methods illustrated from the publications of typical concerns.

What Employee Publications Are Doing to Improve Industrial Relations. 658.3853
W. R. R. Winans. *Industrial Management*, April 1925, pp. 212-214. Subjects suitable for treatment and methods of presenting them.

Where Do Your Workmen Park Their Cars? 658.383
Maxwell Droke. *Factory*, May 1925, pp. 753-754, 788-790. A discussion of the problem of parking employees' cars, which is now faced by every American manufacturing plant whether large or small.

Safety

For Safety, Sanitation and Welfare. 658.315
H. E. Hopkins. *Cement, Mill and Quarry*, April 5, 1925, pp. 7-11. Illus. Safety and industrial relations work at plants of the United States Steel Corporation—Universal Portland Cement Company and Pittsburgh Limestone Company.

Prevention of Eye Injuries. 658.3823
G. R. G. Fisher. *Manufacturers' News*, April 18, 1925, pp. 7, 24, 26. Its importance and suggestions for its accomplishment.

Safe Handling and Use of Compressed Gas Cylinders. 658.3823:662.76
National Safety News, May 1925, pp. 25-27. Illus. Safety rules compiled by the Compressed Gas Manufacturers Association.

Safety in Use of Pyroxyline Base Finishing Materials. 658.3823:661
Harry B. Fox. *National Safety News*, May 1925, pp. 31-32.

Where Employees' Activities Pave the Way for Safety Work. 658.3823
John M. Sandel. *National Safety News*, May 1925, pp. 11-13. Illus. Experiences of two concerns that have made progress in getting employee co-operation for accident prevention.

Wages

The Group Wage Payment Plan. 658.323
H. G. Perkins. *Journal of the Society of Automotive Engineers*, May 1925, pp. 516-523. Discussion of a paper in the November 1924 issue, dealing with a successful application of the group plan at the Maxwell Motor Corporation, and the many good results secured.

Methods of Compensation—II. Analysis of Branch Managers' Contracts. 658.32
Metropolitan Life Insurance Company, New York. Booklet, 23 pp. Summary of items necessary in contract between manufacturers and their branch managers or dealers with examples of satisfactory provisions.

Workmen's Compensation Insurance. 658.3254
G. F. Michelbacher and Thomas M. Nial. McGraw-Hill Book Company, New York. 503 pp. $4. An explanation of the problems and practices of workmen's compensation insurance and the basis of that insurance in industrial activity. The first two sections deal with industrial accidents and their prevention, the history of the employers' liability system, the development of workmen's compensation, and the nature and scope of present laws. The third section is devoted to an exposition of the principles and practices of the business of workmen's compensation, and employers' liability insurance.

Why Workers Choose Jobs. 658.3115
Douglas Fryer. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 519-520. Interest and ambition shown to be strongest appeals in industry.

MANAGEMENT AND ADMINISTRATION

CUMULATIVE INDEX TO VOL. IX

JANUARY—JUNE, 1925

A

ABUSE OF CEMENT FLOORS BY METAL TRUCK WHEELS. May, 420

Accounting (See also Cost Accounting; Financial Analysis; Material Control)
- Practical Results of Budgeting. Allen. June, 527-30
- Production Schedule for Factory Accounting Work. Ross. Apr., 363-4
- Where Have My Profits Gone? Harrison. Feb., 165-8

Advertising
- Export Advertising Practice. De Young, Jan., 29-32
- Measuring Sales Effort Results. McDermid. Jan., 33-7

Air Compressor
- Industrial Equipment. Jan., 76
- Water-Cooled. Industrial Equipment. May, 487

Air Conditioning (See Buildings)

Air Turbine Motor, Portable
- Industrial Equipment. May, 487

Airplane Industry
- Unusual Manufacturing Difficulties—Investigation and Cure. Keyes. Apr., 373-4

Allen, Ralph H.
- Consolidated Tax Returns. Feb., 121-4
- Practical Results of Budgeting. June, 527-30

AMERICAN MANAGEMENT ASSOCIATION ANNUAL CONVENTION. Mar., 275-6

Ames, John H.
- Effective Repair Part Schedules. June, 525-6

Anderson, A. G.
- Good Factory Air Pays in Increased Output. May, 439-42
- Planning the New Building. Feb., 117-20
- Shop Ventilation as an Investment. June, 531-4

Ash Gate, Flat
- Industrial Equipment. Apr., 385

Automobile Industry
- Financing Automobile Sales Abroad. Bauer. Apr., 365-8
- Financing Domestic Automobile Sales. Hanch. May, 475-80
- Profitable Export Market Analysis. Bauer. June, 651-4
- Universal Tow-Bar for Automobiles. Feb., 148

Auto-Teller
- New Model. (Industrial Equipment). Jan., 78

AVOIDING LOSSES IN INCORRECT POWER COST DISTRIBUTION. Polakov. May, 433-6; June, 553-6

AVOIDING TRADE DISPUTES. Jan., 26

Ayres, Leonard P.
- Road Maps of Industry. Jan., 9-10

B

Barber, Joseph H.
- Industrial Budget Methods, IV-V
- Forecasting Your Industry's Cycle. Jan., 15-20
- Is Forecasting Worth While? Feb., 129-33

Barth, Carl G.
- New Graphical Solution. Feb., 143-4

Bauer, George F.
- Financing Automobile Sales Abroad. Apr., 365-8
- Getting Rid of the Export Box. Mar., 241-4
- Profitable Export Market Analysis. June, 561-4

Bearings, Ball
- Industrial Equipment. Jan., 79; Feb., 180

Bechtel, V. R.
- Burroughs Differential Wage Plan Meets Every Requirement. Feb., 135-8

BEECH-NUT PURCHASING SYSTEM CONTROLS ALL MATERIAL AND SUPPLIES. Gore. Mar., 235-40

BETTER PACKAGING METHODS. Mar., 278

BETTER SHIPPING CONTAINERS. Smith. Apr., 349-52; May, 421-4; June, 549-52

Bishop, R. S.
- Steel Sash—More Light. Jan., 27-8

Boiler Room (See Power Plant)

Boiler Room Equipment (See device in question)

Boiler Scale Eliminator
- Industrial Equipment. Mar., 283

Bookkeeping Machine
- Instalment Bookkeeping Machine (Industrial Equipment). Apr., 387

Box Car Unloader
- Industrial Equipment. June, 572

Brunner, H.
- 72% Efficiency and Good Will. Feb., 125-7

Budgeting (See Accounting; Selling)

Buildings and Equipment
- Air Washer and Cooler (Industrial Equipment). Jan., 78
- Automatic Temperature Control (Industrial Equipment). Mar., 285
- Costs in 44 Employees' Lunchrooms. Waldo. Apr., 337-42
- Ford Engineering Laboratory. Hagemann. Mar., 219-22
- Good Factory Air Pays in Increased Output. Anderson. May, 439-42
- Industrial Heating Equipment (Industrial Equipment). Mar., 285
- Inexpensive Coat Rack. Feb., 152
- Long Distance Heating. Curran. June, 567
- New Plant Eliminates Hand Labor. Walker. June, 513-18
- Planning the New Building. Anderson. Feb., 117-20
- Shop Equipment (Industrial Equipment). Jan., 78
- Shop Ventilation as an Investment. Anderson. June, 531-4
- Steel Sash More Light. Bishop. Jan., 27-8
- Steel Shelving in Industry. May, 456

BUILDING AND STARTING THE TOOL CRIB. Christensen. June, 537-40

BUILDING PRODUCTION SCHEDULES FROM SALES, COSTS AND PROFIT ANALYSES. Harrison. May, 461-4

Burners, Combined Gas and Oil
- Industrial Equipment. May, 486

Burnet, Arthur R.
- Charts as Management Tools. Jan., 55-8

BURROUGHS DIFFERENTIAL WAGE PLAN MEETS EVERY REQUIREMENT. Bechtel. Feb., 135-8

Business Forecasting (See also Selling)
- Forecasting Your Industry's Cycle. Barber. Jan., 15-20
- Is Forecasting Worth While? Barber. Feb., 129-33

C

Calculating Machine
- Electric (Industrial Equipment). June, 573
- "Multiplex" (Industrial Equipment). Jan., 77

CANNERY, CONVEYING IN A. May, 482

Car Puller, Electric Capstan
- Industrial Equipment. June, 573

Car Unloader, Box
- Industrial Equipment. June, 572

CARRYING MAIL MECHANICALLY. Wilson, L. A. Jan., 71

Case, Ralph E.
- New Type of Material Control Record. June, 543-8

Casey, Charles C.
- When Your Salesmen Grow Stale. Feb., 157-8

Cement Industry
- Novel Source of Raw Materials Cuts Costs. Jan., 37-8

Chain Block, Ball Bearing
- Industrial Equipment. Mar., 285

Chain Drives, Standardized
- Industrial Equipment. June, 570

Charging Machines (See Material Handling)

Charts
- Cobweb Chart. Conway. June, 565
- Cobweb Chart. Polakov. Mar., 277
- Road Maps of Industry. Ayres. Jan., 9-10

CHARTS AS MANAGEMENT TOOLS. Burnet. Jan., 55-8

CHECK WAGE PAYMENTS AVOID HOLD-UPS. Wagner. May, 465-6

CHEMICALS, TESTING EVERY PACKAGE OF. Mar., 222

Chip Separator
- Industrial Equipment. Mar., 284

Christensen, Anker L.
- Building and Starting the Tool Crib. June, 537-40
- Worthington Methods for Tool Storage, Use and Repair. May, 467-70

Circuit Breakers
- Industrial Equipment. Feb., 178

CLASSIFICATION OF CAUSES FOR VARIATIONS FROM STANDARD LABOR COSTS. Lott. Apr., 347-8

Cleaning (See also Maintenance)
Hydro-Pneumatic Sand Blast. Feb., 173
Machine Cleaning Device (Industrial Equipment). May, 488
Portable Air Turbine Motor (Industrial Equipment). May 487
Clothing Industry (See Garment Industry)
Clutch, Friction
Industrial Equipment. May, 489
CO_2 Meters (See Meters)
Coal Crusher
Industrial Equipment. Apr., 384
Coal Handling (See Material Handling)
Coal Meter (See Meters)
Coal Pulverizer for Direct Firing
Industrial Equipment. June, 571
COBWEB CHART. *Conway.* June, 565
Polakov. Mar., 277
Collar, Safety
Industrial Equipment. Feb., 178
Combustion Chamber Cover and Soot Blower
Industrial Equipment. Apr., 385
CONSOLIDATED TAX RETURNS. Allen. Feb., 121-4
Containers
See also Shipping
Better Packaging Methods. Mar., 278
Better Shipping Containers. Smith. Apr., 349-52; May, 421-4; June, 549-52
Cutting Down Shipping Losses. Squire. Jan., 47-50
Economies of Fiber Shipping Containers. Cornwall. May, 464
Packages That Satisfy the Foreigner. De Young. Feb., 139-42
CONTROLLED PRODUCTION OF KNIT GOODS. Gates. Apr., 343-6
CONTROLLING FURNACE TEMPERATURES. McGillivray. Feb., 173
Conveyors
See also Material Handling
Monorail Cable (Industrial Equipment). Mar., 286
CONVEYOR TO ELEVATE BALES OF STRAW. Apr., 356
CONVEYING IN A CANNERY. May, 482
Conway, J. B.
Cobweb Chart. June, 565
Cooler for Jacket Water
Industrial Equipment. May, 489
Cornwall, H. D.
Economies of Fiber Shipping Containers. May, 464
Cost Accounting (See also Accounting; Financial Analysis)
Classification of Causes for Variations from Standard Labor Costs. Lott. Apr., 347-8
Factory and Foundry Accounting. Thompson. Feb., 169-72
New Cost Formulas for Firebrick. Greenwood. Mar., 261-4
Simplifying Cost and Price Figuring. Rosenthal. June, 535-6
Standard Costs as an Aid to Profits. Harrison. Jan., 41-5
Use of Interest in Figuring Production Cost. Jordan, Feb., 145-8
COST ACCOUNTING FOR SHOP WORK. Thompson. Jan., 67-70
COST ACCOUNTING INCREASES PROFITS. Pelton. Mar., 271-4
COST FINDING SYSTEM FOR GARMENTS. Daughters. May, 443-6
COST OF EXACT KNOWLEDGE. Mar., 276
COSTS IN 44 EMPLOYEES' LUNCHROOMS. Waldo. Apr., 337-42
Cranes (See also Material Handling)
Crawling Tractor (Industrial Equipment). June, 571
Credit Insurance
Protecting Foreign Shipments. Gibson. Jan., 39-40
Curran, L. V.
Long Distance Heating. June, 567
Current Information Index
Jan., 80-6; Feb., 182-88; Mar., 287-94; Apr., 388-94; May, 490-96; June, 574-80
CUTTING DOWN SHIPPING LOSSES. Squire. Jan., 47-50
CUTTING DOWN THE WASTE PILE. Hudson. May, 413-16

D

Daughters, C. D.
Cost Finding System for Garments. May, 443-6
Davis, Ralph C.
Method of Finding Minimum-Cost Quantity in Manufacturing. Apr., 353-6
DEMONSTRATING MACHINERY UNDER POWER. Jan., 50
DESERVING A MANUFACTURING PROFIT. Franklin. Apr., 329-32
De Young, Dirk P.
Export Advertising Practice. Jan., 29-32
Packages That Satisfy the Foreigner. Feb., 139-42
Die Stock
Industrial Equipment. June, 572
Distribution (See Containers; Shipping; Transportation)
Draft and Damper Regulators
Industrial Equipment. Apr., 386
Drill, Pneumatic
Industrial Equipment. May, 486

E

ECONOMIES OF FIBER SHIPPING CONTAINERS. Cornwall. May, 464
Education (See Employee Training)
EFFECTIVE REPAIR PART SCHEDULES. Ames. June, 525-6
EFFICIENCY REPORT FOR RATING FOREMEN. MacGrath. Apr., 371-2
ELECTRIC HEAT IN BATTERY MANUFACTURE. Norris. Apr., 380
ELECTRIC HEAT TO THE RESCUE. Lang. June, 566
ELECTRIC OVEN. Stevenson. Apr., 380
ELECTRIC TRACTORS AID IN SHIPPING. Apr., 360
Electrical Equipment (See device in question)
Electrode Control
Industrial Equipment. Mar., 284
Electrode Holder
Industrial Equipment. Feb., 179
Elevating Platform Truck (See Trucks)
Employee Relations (See Labor Relations)
Employee Training
Engineering Education—For Whom? May, 431-2
How About Training Salesmen? Mar., 269-70
Training the Planning Staff. Ross-Ross. Apr., 375-8
When Your Salesmen Grow Stale. Casey. Feb., 157-8
Employees, Rating of
Efficiency Report for Rating Foremen. MacGrath. Apr., 371-2
Engine, Diesel
Industrial Equipment. June, 570
Engine Room (See Power Plant)
Engine Room Equipment (See device in question)
ENGINEER AS AN EXECUTIVE. May, 474
ENGINEERING EDUCATION—FOR WHOM? May, 431-2
ENTER ORDER—WHEN WILL YOU SHIP? Riggs. Mar., 253-7
Eppelsheimer, P. C.
Generating Power at Lowest Cost. Jan., 11-14
Equipment (See Buildings; Machinery; and device in question)
EQUIPMENT FOR CLEANING THE SHOP FLOOR. Mar., 260
EXPORT ADVERTISING PRACTICE. De Young. Jan. 29-32
Export Trade (See Trade, Foreign)

F

FACTORY AND FOUNDRY ACCOUNTING. Thompson. Feb., 169-72
Fans
Engine Driven (Industrial Equipment). May, 487
Industrial Heating Equipment (Industrial Equipment). Mar., 285
$15,000,000 SALVAGED BY FORD PLANTS. Hagemann. June, 557-60
FILE SURVEY SHEET. Feb., 175
Financial Analysis (See also Accounting; Cost Accounting)
Building Production Schedules from Sales, Costs and Profit Analyses. Harrison. May, 461-4
Financial Statement Analysis. Stevenson. Mar., 223-8
Picking the Profitable Products. Rosenthal. May, 429-31
Practical Methods of Analyzing Loss in Manufacturing Profit. Harrison. Mar., 249-52
FINANCIAL STATEMENT ANALYSIS. Stevenson. Mar., 223-8
FINANCING AUTOMOBILE SALES ABROAD. Bauer. Apr., 365-8
FINANCING DOMESTIC AUTOMOBILE SALES. Hanch. May, 475-80
Fire Protection
Automatic Fire Extinguisher (Industrial Equipment). Feb., 179
Foam Fire Engine (Industrial Equipment). Jan., 77
Reducing Oil Tank Fire Hazard. May, 483
Safety Nozzle for Gasoline Lines. May, 481
Firebrick Cost Formulas
New Cost Formulas for Firebrick. Greenwood. Mar., 261-4
Fish, E. H.
Matching Production to Demand. Jan., 10
Why Is an Office Manager? Jan., 71
FORD ENGINEERING LABORATORY. Hagemann. Mar., 219-22
Forecasting (See Business Forecasting)
FORECASTING YOUR INDUSTRY'S CYCLE. Barber. Jan., 15-20
Franklin, B. A.
Work of the Industrial Executive, V-VIII
Profit-Making Management in the Factory. Jan., 21-6
Profit-Making Factory Equipment. Feb., 149-52
Profit-Making Possibilities in Seeing Marketing Essentials. Mar., 245-8
Deserving a Manufacturing Profit. Apr., 329-32

Freeland, Willard E. and Thompson, Sanford E.
Savings Through Management in the Rubber Industry. May, 447-50
Freight (See Shipping)
Fryer, Douglas
Why Workers Choose Jobs. June, 519-20
Furnaces
Electric Furnace Element (Industrial Equipment). Mar., 282
Electric Oven. Stevenson. Apr., 380
Electrode Control (Industrial Equipment). Mar., 284
Small Electric Furnace (Industrial Equipment). Feb., 178
Furniture Industry
Southern Furniture Plants Apply Modern Management with Success. Scribner. June, 521-4

G

Gage, Precision Checking
Industrial Equipment. June, 572
GAINING THE WORKERS' CONFIDENCE. Walker. June, 541-2
Garment Industry
Controlled Production of Knit Goods. Gates. Apr., 343-6
Cost Finding System for Garments. Daughters. May, 443-6
Standards in Clothing Manufacture. Saum. Jan., 59-61
Gasoline Handling (See also Oil)
Safety Nozzle for Gasoline Lines. May, 481
Gates, Herbert C.
Controlled Production of Knit Goods. Apr., 343-6
Geiger, Charles W.
Handling Coal in Alameda. Feb., 158
GENERATING POWER AT LOWEST COST. Epplesheimer. Jan., 11-14
GERMAN FINANCE AND INDUSTRY. Staub. Apr., 321-4
GETTING RID OF THE EXPORT BOX. Bauer. Mar., 241-4
Gibson, H. L.
Protecting Foreign Shipments. Jan., 39-40
Glass Industry
Temperature Control in Glass Manufacture. Apr., 379
GOOD FACTORY AIR PAYS IN INCREASED OUTPUT. Anderson. May, 439-42
Gore, John
Beech-Nut Purchasing System Controls All Material and Supplies. Mar., 235-40
Graham, Willard J.
Methods to keep Inventories Down to a Minimum. May, 471-4
Greene, Arthur L.
Reducing Die Costs. Jan., 73
Specifying Screw Threads When Purchasing. Mar., 277
Greenwood, George W.
New Cost Formulas for Firebrick. Mar., 261-4
Grinders, "Roto"
Industrial Equipment. Apr., 385

H

Hagemann, George E.
Ford Engineering Laboratory. Mar., 219-22
$15,000,000 Salvaged by Ford Plants. June, 557-60
Money-Saving Material Handling (Conveyors, Cranes and Hoists). Feb., 153-6
Savings in Material Handling (Conveyor Systems and Coal Handling Equipment). Jan., 51-4
21 Material-Handling Installations Which Have Saved Money (Trucks, Tractors and Cupola Charges). Apr., 357-9
Hainsworth, Warren
Sales District Rating Scale. Apr., 381
Hanch, C. C.
Financing Domestic Automobile Sales. May, 475-80
HANDLING A COMPLEX MATERIAL INVENTORY. Rosenthal. Mar., 267-9
HANDLING AND STORING OIL AND GASOLINE. Feb. 134
HANDLING COAL IN ALAMEDA. Geiger. Feb., 158
HANDLING FREIGHT WITH ELECTRIC TRUCKS. May, 482.
HANDY HOLDER FOR DAILY TIME CARDS. Mar., 279
Hanger Seal, Dust-Proof
Industrial Equipment. May, 487
Harrison, G. Charter
Working Plans for Profits, IV-VII
Standard Costs as an Aid to Profits. Jan., 41-5
Where Have My Profits Gone? Feb., 165-8
Practical Methods of Analyzing Loss in Manufacturing Profit. Mar., 249-52
Building Production Schedules from Sales, Costs and Profit Analyses. May, 461-4
Heat Treating
Controlling Furnace Temperatures. McGillivray. Feb. 173
Electric Heat to the Rescue. Lang. June, 566
Electric Oven. Stevenson. Apr., 380
Savings by Electric Annealing. Mar., 279
Heating (See Buildings)
Hoists (See also Material Handling)
Electric (Industrial Equipment). Jan., 76
Starter (Industrial Equipment). Apr., 387
HOOD RUBBER SALES BUDGETS. Stillman. May, 417-20
HOW ABOUT TRAINING SALESMEN? Mar., 269-70
HOW MANY PEOPLE WILL BUY THE PRODUCT YOU HAVE TO SELL? Ullman. Apr., 361-2
Hudson, R. M.
Cutting Down the Waste Pile. May, 413-16
HYDRO-PNEUMATIC SAND BLAST. Feb., 173

I

IDENTIFICATION OF INDUSTRIAL PIPING SYSTEMS. Jan., 62
Index to Current Management Literature (See Current Information Index)
Indicators (See device in question)
INDUSTRIAL BUDGET METHODS. Barber. Jan., 15-20; Feb. 129-33
INEXPENSIVE COAT RACK. Feb., 152
Instruments (See device in question)
Insurance, Unemployment
Suggestions on Unemployment Insurance. Stender. Mar., 228
INTERNATIONAL WELFARE CONGRESS. Apr., 324
Inventory (See Material Control)
IS FORECASTING WORTH WHILE? Barber. Feb., 129-33

J

Johnson, O. R.
Thrift Plans for Employees. Apr., 369-71
Jordan, J. P.
Use of Interest in Figuring Production Cost. Feb., 145-8

K

Kelligon, A. L.
$612,955 Saved by Waste Reclamation. May, 457-60
Kent, Robert T.
Making Freight Shipments Pay Profits. Feb., 159-62
Keyes, C. Roy
Unusual Manufacturing Difficulties—Investigation and Cure. Apr., 373-4
Killinger, C. E.
New Methods Cut Power Plant Costs. Apr., 325-8
Kimball, Dexter S.
Twenty Years of Modern Management. Feb., 113-16

L

Labor Relations (See also Employee Training; Employees, Rating of)
Costs in 44 Employees' Lunchrooms. Waldo. Apr., 337-42
Gaining the Worker's Confidence. Walker. June, 541-2
International Welfare Congress. Apr., 324
Let Your Workmen Think—It Pays! Onion. Mar., 259-60
Lynn Plan of Shop Representation. Ringer. Feb., 163-4
New Model Auto Teller (Industrial Equipment). Jan., 78
Provide Employee Recreational Facilities. May, 450
Recreation That Pays. Mar., 240
Thrift Plans for Employees. Johnson. Apr., 369-71
Unique Works Contest. Feb., 174
Why Workers Choose Jobs. Fryer. June, 519-20
Lang, S. L.
Electric Heat to the Rescue. June, 566
LET YOUR WORKMEN THINK—IT PAYS! Onion. Mar., 259-60
Lifting Machines (See Trucks)
Light-Bulb Lock
Industrial Equipment. Jan., 79
Lighting (See Buildings)
Loaders, Portable Electric
Industrial Equipment. Feb., 180
LONG DISTANCE HEATING. Curran. June, 567
Lott, Merrill R.
Classification of Causes for Variations from Standard Labor Costs. Apr., 347-8
Wage Scales with a Reason. May, 451-5
LOW BODY AUTO TRUCK FOR HANDLING MATERIAL. Jan., 46
Lukens, W. Penn.
Waste Elimination Through Executive Control. Jan., 63-6
LUMBER HANDLING SIMPLIFIED. Perry. Mar., 229-32
Lunchrooms
Costs in 44 Employees' Lunchrooms. Waldo. Apr., 337-42
LYNN PLAN OF SHOP REPRESENTATION. Ringer. Feb., 163-4

M

McCausland, James R.
Storing Coal Without Danger of Spontaneous Combustion. Apr., 379
MacGrath, Kenneth
Efficiency Report for Rating Foremen. Apr., 371-2
McDermid, W. A.
Measuring Sales Effort Results. Jan., 33-7
McGillivray, R. H.
Controlling Furnace Temperatures. Feb., 173
Machinery
Demonstrating Machinery Under Power. Jan., 50
Profit-Making Factory Equipment. Franklin. Feb., 149-52
Mail Delivery
Carrying Mail Mechanically. Wilson. Jan., 71
Maintenance
Abuse of Cement Floors by Metal Truck Wheels. May, 420
Effective Repair Part Schedules. Ames. June, 525-6
Equipment for Cleaning the Shop Floor. Mar., 260
Portable Pipe-Wrapping Machine Aids Maintenance. Feb., 116
Preventing Defacement of Property. Van Nice. Jan., 72
Vacuum Cleaning with Compressed Air. Jan., 72
MAKING FREIGHT SHIPMENTS PAY PROFITS. Kent. Feb., 159-62
Management (See also item in question)
Deserving a Manufacturing Profit. Franklin. Apr., 329-32
Profit-Making Factory Equipment. Franklin. Feb., 149-52
Profit-Making Management in the Factory. Franklin. Jan., 21-6
Savings Through Management in the Rubber Industry. Thompson and Freeland. May, 447-50
Shop Management in Pioneer Days. Rice. Mar., 217-18
Southern Furniture Plants Apply Modern Management with Success. Scribner. June, 521-4
Twenty Years of Modern Management. Kimball. Feb., 113-16
Unusual Manufacturing Difficulties—Investigation and Cure. Keyes. Apr., 373-4
Waste Elimination Through Executive Control. Lukens. Jan., 63-6
Why Is an Office Manager? Fish. Jan., 71
MANAGEMENT AND STANDARDIZATION. June, 548
MANAGEMENT'S ATTACK ON WASTE. Swope. June, 511-512
Market Analysis (See Selling)
MATCHING PRODUCTION TO DEMAND. Fish. Jan., 10
Material Control (See also Accounting; Purchasing)
Handling a Complex Material Inventory. Rosenthal. Mar., 267-9
Methods to Keep Inventories Down to a Minimum. Graham. May, 471-4
New Type of Material Control Record. Case. June, 543-8
Testing Every Package of Chemicals. Mar., 222
Material Handling (See also equipment in question)
Carrying Mail Mechanically. Wilson. Jan., 71
Conveying in a Cannery. May, 482
Electric Tractors Aid in Shipping. Apr., 360
Handling Coal in Alameda. Geiger. Feb., 158
Lumber Handling Simplified. Perry. Mar., 229-32
Money-Saving Material Handling (Conveyors, Cranes and Hoists). Hagemann. Feb., 153-6
New Methods Cut Power Plant Costs. Killinger. Apr., 325-8
New Plant Eliminates Hand Labor. Walker. June, 513-18
Savings in Material Handling (Conveyor Systems and Coal Handling Equipment). Hagemann. Jan., 51-4
21 Material Handling Installations Which Have Saved Money (Trucks, Tractors and Cupola Chargers). Hagemann. Apr., 357-9
MATERIAL HANDLING FOR HIGH-SPEED, STRAIGHT-LINE FLOW OF WORK. Wayman. May, 425-8
MEASURING SALES EFFORT RESULTS. McDermid. Jan., 33-7
METHOD OF FINDING MINIMUM-COST QUANTITY IN MANUFACTURING. Davis. Apr., 353-6
METHODS TO KEEP INVENTORIES DOWN TO A MINIMUM. Graham. May, 471-4
Meters
"Apex" CO_2 Recorder (Industrial Equipment). Jan., 79
CO_2 Recorder and Indicator (Industrial Equipment). Feb., 180
Coal Meter (Industrial Equipment). Feb., 178
Electric CO_2 Meter (Industrial Equipment). Mar., 284
Electric Meters (Industrial Equipment). Apr., 386
Flow Meter (Industrial Equipment). May, 486
MIRROR HELPS ELEVATOR TRAFFIC. May, 481
MONEY-SAVING MATERIAL HANDLING (CONVEYORS, CRANES AND HOISTS). Hagemann. Feb., 153-6
Monorail Cable Conveyor
Industrial Equipment. Mar., 286
Motor Starters
Industrial Equipment. Mar., 285; May, 488
Motors
D. C. (Industrial Equipment). June, 570
Synchronous (Industrial Equipment). May, 487

N

NEW COST FORMULAS FOR FIREBRICK. Greenwood. Mar., 261-4
NEW GRAPHICAL SOLUTION. Barth. Feb., 143-4
NEW METHODS CUT POWER PLANT COSTS. Killinger. Apr., 325-8
NEW PLANT ELIMINATES HAND LABOR. Walker. June, 513-18
NEW TYPE OF MATERIAL CONTROL RECORD. Case. June, 543-8
NEW TYPE OF MOTOR BUS. Mar., 258
Newspaper Production
Material Handling for High Speed Straight Line Flow of Work. Wayman. May, 425-8
Norris, P. E.
Electric Heat in Battery Manufacture. Apr., 380
NOVEL SOURCE OF RAW MATERIALS CUTS COSTS. Jan. 37-8

O

Office Equipment (See device in question)
Office Methods
File Survey Sheet. Feb., 175
Office Supplies (See Purchasing)
Oil Handling
Handling and Storing Oil and Gasoline. Feb., 134
Oil Reclaimer, Crank-Case
Industrial Equipment. May, 488
Oil Tanks
Reducing Oil Tank Fire Hazard. May, 483
Onion, W. E.
Let Your Workmen Think—It Pays! Mar., 259-60
Organization, Shop
Cost of Exact Knowledge. Mar., 276

P

PACKAGE PASSES. May, 481
Packing (See Containers; Shipping)
PACKAGES THAT SATISFY THE FOREIGNER. De Young, Feb., 139-42
Paint, Concrete-Waterproofing
Industrial Equipment. May, 489
Paper Industry
Conveyor to Elevate Bales of Straw. Apr., 356
Patents
Avoiding Trade Disputes. Jan., 26
What Are Patents Worth? Toulmin. Mar., 265-6
Pay-Roll
Form Holder for Pay-Roll Machine (Industrial Equipment). Mar., 283
Pelton, G. M.
Cost Accounting Increases Profits. Mar., 271-4
Perry, Thomas D.
Lumber Handling Simplified. Mar., 229-32
Personnel (See Employee Training; Employees, Rating of; Labor Relations)
PICKING THE PROFITABLE PRODUCTS. Rosenthal. May, 429-31
PLANNING THE NEW BUILDING. Anderson. Feb., 117-20
PLANT BUS SERVICE. Feb., 174
Plant Protection
Package Passes. May, 481
"Undesirables Keep Out!" Stowell. May, 437-8
Pneumatic Tools (See device in question)
Polakov, Walter N.
Avoiding Losses in Incorrect Power Cost Distribution. May, 433-6; June, 553-6
Cobweb Chart. Mar., 277
Pole, Rust-Resisting
Industrial Equipment. Feb., 181
PORTABLE PIPE-WRAPPING MACHINE AIDS MAINTENANCE. Feb., 116
PORTABLE REPAIR SHOP. May, 483
Power Demand Regulator
Industrial Equipment. Apr., 385
Power Plant Equipment (See device in question)
Power Plant Operation
Avoiding Losses in Incorrect Power Cost Distribution. Polakov. May, 433-6; June, 553-6
Generating Power at Lowest Cost. Eppelsheimer. Jan., 11-14
New Methods Cut Power Plant Costs. Killinger. Apr., 325-8
72% Efficiency and Good Will. Brunner. Feb., 125-7

Power Transmission (See also device in question)
Angular Transmission (Industrial Equipment). Jan., 77
Rust-Resisting Pole (Industrial Equipment). Feb., 181
PRACTICAL LOT QUANTITY FORMULA. June 565
PRACTICAL METHODS OF ANALYZING LOSS IN MANUFACTURING PROFIT. Harrison. Mar., 249-52
PRACTICAL RESULTS OF BUDGETING. Allen. June, 527-30
PREVENTING DEFACEMENT OF PROPERTY. Van Nice. Jan., 72
Production Control
Controlled Production of Knit Goods. Gates. Apr., 343-6
Effective Repair Part Schedules. Ames. June, 525-6
Enter Order—When Will You Ship? Riggs. Mar., 253-7
Matching Production to Demand. Fish. Jan., 10
Method of Finding Minimum-Cost Quantity in Manufacturing. Davis. Apr., 353-6
Practical Lot Quantity Formula. June, 565
Production Tickets Co-ordinate Departments. Apr., 378
Production Counters
Industrial Equipment. June, 573
PRODUCTION SCHEDULE FOR FACTORY ACCOUNTING WORK. Ross. Apr., 363-4
PRODUCTION TICKETS CO-ORDINATE DEPARTMENTS. Apr., 378
PROFIT-MAKING FACTORY EQUIPMENT. Franklin. Feb., 149-52
PROFIT-MAKING MANAGEMENT IN THE FACTORY. Franklin. Jan., 21-6
PROFIT-MAKING POSSIBILITIES IN SEEING MARKETING ESSENTIALS. Franklin. Mar., 245-8
PROFITABLE EXPORT MARKET ANALYSIS. Bauer. June, 561-4
PROGRESS IN SIMPLIFICATION. June, 512
PROTECTING FOREIGN SHIPMENTS. Gibson. Jan., 39-40
PROVIDE EMPLOYEE RECREATIONAL FACILITIES. May, 450
Pumps, Centrifugal
Industrial Equipment. Mar., 284
Purchasing (See also Material Control)
Beech-Nut Purchasing System Controls All Materials and Supplies. Gore. Mar., 235-40
Specifications for the Purchase of Office Supplies. Sherran. Apr., 333-6
Specifying Screw Threads When Purchasing. Greene. Mar., 277
Pyrometers
Indicating (Industrial Equipment). Feb., 179
Unit (Industrial Equipment). Feb., 179

R

RECENT PROGRESS IN STANDARDIZATION. May, 480
Recording Instrument (See device in question)
RECREATION THAT PAYS. Mar., 240
REDUCING DIE COSTS. Greene. Jan., 73
REDUCING OIL TANK FIRE HAZARD. May, 483
Reduction Gears
Speed Transformers (Industrial Equipment). Mar., 282
Worm Gear Speed Reducer (Industrial Equipment). Mar., 283; June, 571
Regulators (See device in question)
Repair Shop, Portable
May, 483
Repairs (See Maintenance)
Resistor Unit
Industrial Equipment. Feb., 179
REVIEW OF INDUSTRIAL STANDARDIZATION DEVELOPMENTS. Feb., 128
Rice, E. W., Jr.
Shop Management in Pioneer Days. Mar., 217-18
Riggs, H. S.
Enter Order—When Will You Ship? Mar., 253-7
Ringer, Stanley S.
Lynn Plan of Shop Representation. Feb., 163-4
Riveter, Portable
Industrial Equipment. Feb., 178
ROAD MAPS OF INDUSTRY. Ayres. Jan., 9-10
Rope, Wire
Industrial Equipment. May, 487
Rosenthal, Rudolph
Handling a Complex Material Inventory. Mar., 267-9
Picking the Profitable Products. May, 429-31
Simplifying Cost and Price Figuring. June, 535-6
Ross, Donald
Production Schedule for Factory Accounting Work., Apr., 363-4
Ross-Ross, Donald
Training the Planning Staff. Apr., 375-8
Rubber Industry
Savings Through Management in the Rubber Industry. Thompson and Freeland. May, 447-50

S

SAFETY NOZZLE FOR GASOLINE LINES. May, 481
SALES DISTRICT RATING SCALE. Hainsworth. Apr., 381
Salvage (See Waste Reclamation)
Sand Blast (See Cleaning)
Saum, George E. F.
Standards in Clothing Manufacture. Jan., 59-61
Savings (See Labor Relations)
SAVINGS BY ELECTRIC ANNEALING. Mar., 279
SAVINGS IN MATERIAL HANDLING (CONVEYOR SYSTEMS AND COAL HANDLING EQUIPMENT). Hagemann. Jan., 51-4
SAVINGS THROUGH MANAGEMENT IN THE RUBBER INDUSTRY. Thompson and Freeland. May, 447-50
Scale, Sizing
Industrial Equipment. Apr., 387
Scheduling (See Production Control)
Screw Threads
Specifying Screw Threads When Purchasing. Greene. Mar., 277
Scribner, Charles
Southern Furniture Plants Apply Modern Management with Success. June, 521-4
Selling (See also Business Forecasting; Trade, Foreign)
Demonstrating Machinery Under Power. Jan., 50
Financing Domestic Automobile Sales. Hanch. May, 475-80
Hood Rubber Sales Budgets. Stillman. May, 417-20
How Many People Will Buy the Product You have to Sell? Ullman. Apr., 361-2
Measuring Sales Effort Results. McDermid. Jan., 33-7
Profit-Making Possibilities in Seeing Marketing Essentials. Franklin. Mar., 245-8
Profitable Export Market Analysis. Bauer. June, 561-4
Sales District Rating Scale. Hainsworth. Apr., 381
72% EFFICIENCY AND GOOD WILL. Brunner. Feb., 125-7
Shelving (See Buildings)
Sherran, Robert
Specifications for the Purchase of Office Supplies. Apr., 333-6
Shipping (See also Containers; Material Handling; Transportation)
Getting Rid of the Export Box. Bauer. Mar., 241-4
Making Freight Shipments Pay Profits. Kent. Feb., 159-62
Simple Methods of Reducing Damage to Shipments. Upson. Mar., 233-4
Shop Equipment (See device in question)
SHOP MANAGEMENT IN PIONEER DAYS. Rice. Mar., 217-18
SHOP VENTILATION AS AN INVESTMENT. Anderson. June, 531-4
SIMONDS, ALVAN T., ECONOMIC PRIZES. Mar., 252
SIMPLE METHODS OF REDUCING DAMAGE TO SHIPMENTS. Upson. Mar., 233-4
Simplification (See Standardization)
SIMPLIFYING COST AND PRICE FIGURING. Rosenthal. June, 535-6
$612,955 SAVED BY WASTE RECLAMATION. Kelligon. May, 457-60
Smith, Floyd T.
Better Shipping Containers. Apr., 349-52; May, 421-4; June, 549-52
Soot Blower
Combination Chamber Cover and Soot Blower (Industrial Equipment). Apr., 385
SOUTHERN FURNITURE PLANTS APPLY MODERN MANAGEMENT WITH SUCCESS. Scribner. June, 521-4
Specifications (See Purchasing)
SPECIFICATIONS FOR FORGED BOLTS. May, 483
SPECIFICATIONS FOR THE PURCHASE OF OFFICE SUPPLIES. Sherran. Apr., 333-6
SPECIFYING SCREW THREADS WHEN PURCHASING. Greene. Mar., 277
Speed Transformers (See Reduction Gears)
Squire, H. H.
Cutting Down Shipping Losses. Jan., 47-50
Stacking Machines (See Trucks)
STANDARD COSTS AS AN AID TO PROFITS. Harrison. Jan., 41-5
Standardization
Identification of Industrial Piping Systems. Jan., 62
Management and Standardization. June, 548
Progress in Simplification. June, 512
Recent Progress in Standardization. May, 480
Review of Industrial Standardization Developments. Feb., 128
Work of the Division of Simplified Practice. Jan., 14
STANDARDS IN CLOTHING MANUFACTURE. Saum. Jan., 59-61
Statistics (See Charts)
Staub, E. Elmer
German Finance and Industry. Apr., 321-4

Steam Trap
Industrial Equipment. Feb., 179
STEEL SASH—MORE LIGHT. Bishop. Jan., 27-8
STEEL SHELVING IN INDUSTRY. May, 456
Stender, L. L.
Suggestions on Unemployment Insurance. Mar., 228
Stevenson, C. H.
Electric Oven. Apr., 380
Stevenson, Spencer B.
Financial Statement Analysis. Mar., 223-8
Stillman, K. W.
Hood Rubber Sales Budgets. May, 417-20
Stokers, Traveling Grate
Industrial Equipment. Mar., 282; May, 486
Storing (See material in question)
STORING COAL WITHOUT DANGER OF SPONTANEOUS COMBUSTION. McCausland. Apr., 379
Stowell, L. M.
"Undesirables Keep Out!" May, 437-8
Suggestion Systems
Let Your Workmen Think—It Pays! Onion. Mar., 259-60
SUGGESTIONS ON UNEMPLOYMENT INSURANCE. Stender. Mar., 228
Switch, Safety
Industrial Equipment. Jan., 77; Feb., 180
Swope, Gerard
Management's Attack on Waste. June, 511-12

T

Taxes
Consolidated Tax Returns. Allen. Feb., 121-4
Temperature Control (See Buildings; Heat Treating)
TEMPERATURE CONTROL IN GLASS MANUFACTURE. Apr., 379
Temperature Recorder
Recording Instrument (Industrial Equipment). Apr., 384
TESTING EVERY PACKAGE OF CHEMICALS. Mar., 222
Thompson, Gaylord G.
Cost Accounting for Shop Work. Jan., 67-70
Factory and Foundry Accounting. Feb., 169-72
Thompson, Sanford E., and Freeland, Willard E.
Savings Through Management in the Rubber Industry. May, 447-50
THRIFT PLANS FOR EMPLOYEES. Johnson. Apr., 369-71
Tiering Machines (See Trucks)
Time Keeping
Handy Holder for Daily Time Cards. Mar., 279
Time Study
New Graphical Solution. Barth. Feb., 143-4
Tool Balancer
Balancer of Portable Tools (Industrial Equipment). Apr., 386
Tool Control
Building and Starting the Tool Crib. Christensen. June. 537-40
Worthington Methods for Tool Storage, Use and Repair. Christensen. May, 467-70
Tool Making
Reducing Die Costs. Greene. Jan., 73
Tool Storage (See Tool Control)
Toulmin, H. A., Jr.
What Are Patents Worth? Mar., 265-6
Tractors (See Material Handling)
Trade, Domestic (See Selling)
Trade, Foreign (See also Selling)
Financing Automobile Sales Abroad. Bauer. Apr., 365-8
German Finance and Industry. Staub. Apr., 321-4
Getting Rid of the Export Box. Bauer. Mar., 241-4
Profitable Export Market Analysis. Bauer. June, 561-4
Protecting Foreign Shipments. Gibson. Jan., 39-40
Traffic (See also Transportation)
Mirror Helps Elevator Traffic. May, 481
Training (See Employee Training)
TRAINING THE PLANNING STAFF. Ross-Ross. Apr., 375-8
Transformer Load Indicator
Industrial Equipment. Apr., 384
Transmission (See Power Transmission)
Transportation (See also Shipping)
Low Body Auto Truck for Handling Material. Jan., 46
New Type of Motor Bus. Mar., 258
Plant Bus Service. Feb., 174
Trucks (See also Material Handling)
Dolly (Industrial Equipment). June, 571
Electric Tiering Machines (Industrial Equipment). June, 570
Elevating Platform (Industrial Equipment). Jan., 78
Handling Freight with Electric Lift Truck. May, 482
Low Body Auto Truck for Handling Material. Jan., 46
Stacking Tructors (Industrial Equipment). Jan., 76
TWENTY YEARS OF MODERN MANAGEMENT. Kimball. Feb., 113-16
21 MATERIAL-HANDLING INSTALLATIONS WHICH HAVE SAVED MONEY (TRUCKS, TRACTORS AND CUPOLA CHARGERS). Hagemann. Apr., 357-9

U

Ullman, Roland G. E.
How Many People Will Buy the Product You Have to Sell? Apr., 361-2
"UNDESIRABLES KEEP OUT!" Stowell. May, 437-8
Unemployment Insurance (See Insurance)
Unions, Pipe
(Industrial Equipment). Feb., 180
UNIQUE WORKS CONTEST. Feb., 174
UNIVERSAL TOW-BAR FOR AUTOMOBILES. Feb., 148
UNUSUAL MANUFACTURING DIFFICULTIES—INVESTIGATION AND CURE. Keyes. Apr., 373-4
Upson, W. H., Jr.
Simple Methods of Reducing Damage to Shipments. Mar., 233-4
USE OF INTEREST IN FIGURING PRODUCTION COST. Jordan. Feb., 145-8

V

VACUUM CLEANING WITH COMPRESSED AIR. Jan., 72
Valve Movement Indicator
Industrial Equipment. Jan., 78
Valve, Quick Action
Industrial Equipment. Jan., 79
Van Nice, J. Horace
Preventing Defacement of Property. Jan., 72
Ventilation (See Buildings)

W

Wage Payment
Burroughs Differential Wage Plan Meets Every Requirement. Bechtel. Feb., 135-8
Check Wage Payments Avoid Hold-Ups. Wagner. May, 465-6
WAGE SCALES WITH A REASON. Lott. May, 451-5
Wagner, Edward S.
Check Wage Payments Avoid Hold-Ups. May, 465-6
Waldo, Russell J.
Costs in 44 Employees' Lunchrooms. Apr., 337-42
Walker, A. P.
New Plant Eliminates Hand Labor. June, 513-18
Walker, P. F.
Gaining the Workers' Confidence. June, 541-2
Waste Elimination
Cutting Down the Waste Pile. Hudson. May, 413-16
$15,000,000 Salvaged by Ford Plants. Hagemann. June, 457-60
Management's Attack on Waste. Swope. June, 511-12
$612,955 Saved by Waste Reclamation. Kelligon. May, 557-60
WASTE ELIMINATION THROUGH EXECUTIVE CONTROL. Lukens. Jan., 63-6
Wayman, Mark
Material Handling for High-Speed, Straight-Line Flow of Work. May, 425-8
Welding
Electrode Holder (Industrial Equipment). Feb., 179
Low Pressure Welding Torch (Industrial Equipment). June, 572
Portable Arc Welder (Industrial Equipment). Mar., 286
Portable Electric Welder (Industrial Equipment). June, 573
Unit (Industrial Equipment). Jan., 79
WHAT ARE PATENTS WORTH? Toulmin. Mar., 265-6
WHEN YOUR SALESMEN GROW STALE. Casey. Feb., 157-8
WHERE HAVE MY PROFITS GONE? Harrison. Feb., 165-8
WHY IS AN OFFICE MANAGER? Fish. Jan., 71
WHY WORKERS CHOOSE JOBS. Fryer. June, 519-20
Wilson, L. A.
Carrying Mail Mechanically. Jan., 71
Work Benches
Shop Equipment (Industrial Equipment). Jan., 78
WORK OF THE DIVISION OF SIMPLIFIED PRACTICE. Jan., 14
WORK OF THE INDUSTRIAL EXECUTIVE. Franklin. Jan., 21-6; Feb., 149-52; Mar., 245-8; Apr., 329-32
WORKING PLANS FOR PROFITS. Harrison. Jan., 41-5; Feb., 165-8; Mar., 249-52; May, 461-4.
WORTHINGTON METHODS FOR TOOL STORAGE, USE AND REPAIR. Christensen. May, 467-70
Wrenches, Electric Socket
Industrial Equipment. Feb., 181

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MANAGEMENT
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MANUFACTURING INDUSTRIES

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American Manufacturing Management Sure of Adoption in Europe

Our Methods "Only Way to Increase Production and Reduce Costs"

EUROPE is turning greedily to American management methods. In the fight for higher production and lower costs, European manufacturers believe they have much to learn from American experience, and are seeking to understand and apply that practice in organization and direction that has aided so profoundly in achieving our industrial supremacy.

This adoption of our fundamentals, systems and procedure is an outside evaluation of the worth of modern manufacturing management. Not only are the foreigners interested in and eager to know about what we are doing but they give unstinted praise of our practice by introducing it into their shops and offices. These circumstances should strengthen our faith in the soundness of our own management development.

Four events in about two years' time give striking proof of this European belief in American management and the methods which it has developed.

In 1923 there was held in Paris a *"Conférence de l'Organization Francaise"* at which the administration of manufacturing enterprise was discussed at length and new impetus given to the already strongly supported movement to improve the organization and operation of French industrial plants by the introduction of "scientific management."

In July 1924, the first International Management Congress met in Prague for a four-day session. It was an event of major importance. The gathering was planned by the government of Czecho-Slovakia as a means of introducing into that country those management methods that have helped to make industrial America.

The Congress was international in character, with over 500 delegates from 13 countries. These included government representatives, engineers and industrial leaders of Central Europe. In their point of view and discussions they revealed a deep-seated hope of economic and industrial improvement through the adoption of American methods. The belief could not be escaped that these men had investigated and pondered over the serious problems of industrial and manufacturing operation and were earnestly seeking for information of useful and usable character.

In summing up the work of the first International Management Congress these observations were made and generally accepted:

1. Central Europe is profoundly stirred by the possibilities in American management methods.
2. But few efforts have been made in Central Europe to develop and apply scientific management methods.
3. Results of the contact which Central Europe has had with American practice have been up to the present time inspirational rather than informative.
4. Engineers and industrialists of Central Europe evaluate American management methods in highest terms.

Manufacturers of Europe are facing the situation that confronts us: How to operate profitably. Costs do not go down of themselves; they must be forced down by good management. European manufacturers believe we have this kind of management and, particularly in Continental countries, are turning to us for our methods and practice. One outstanding event, a high tribute to American management, is the translation and publication of "Management's Handbook" by the *Verein Deutscher Ingenieure*.

An immediate result of the Prague Conference was the National Convention of the Association for Scientific Management in Poland, held in Warsaw, December 6-8, 1924. Over 450 were registered, including delegates from the 12 local chapters of the Association.

Many of the papers given at Prague by the American representatives were re-presented at Warsaw, with others prepared by members of the Polish association. Particular attention was given to the results of the practical application of scientific management methods in Polish industries, of which there are several outstanding examples.

Proof that the interest thus aroused is being sustained is found in the program for the Congress on Scientific Management to be held in Brussels in October 1925. It is to be under the patronage of the King of Belgium and the Belgian government. Seven general topics are on the program for discussion, five of which directly concern manufacturing operations:

1. Organizing Problems in General
2. Organization of Production
3. Supplying Raw Materials
4. Cost Control
5. Sales Organization
6. Office Organization
7. Scientific Management Applied to State Services

The statement of the purpose of the Congress declares that it is to show the possibilities of scientific management and to bring before manufacturers and managers actual examples of the economies to be realized by the use of such methods. Emphasis is to be placed on experience, actual results, facts, and methods practically applicable in the daily work of manufacturing.

The important question of the moment confronting the Belgian manufacturer is stated to be "the necessity to reduce cost prices." On this point a statement giving the aim of the Congress has this to say:

> Raw materials rise steadily in price and there are constant claims from labor for wage increases. In the buying markets, orders are growing scarcer and competition is becoming keener. Export is becoming more difficult on account of ever-increasing tariff barriers, placing before manufacturers the problem of selling the finished product more cheaply while paying more for his raw materials and wages.
>
> There is only one way out: reducing cost by a better utilization of capital, raw materials and labor, in other words, by *scientific management.*

A Tribute to American Management

The fourth tribute to American management methods comes from German engineering in the translation of "Management's Handbook" into German by the *Verein Deutscher Ingenieure,* the greatest engineering society of Germany and the largest in membership in the world. This translation is now under way; the work will be published by the publishing house of the Verein, and under the auspices of that society.

Dr. Conrad Matchoss, in the course of negotiations for this translation, wrote:

> It is the desire of our society to have our German engineers become better acquainted with the work, aims and ideals of American engineers than can be possible by lectures on such subjects. We believe that the translation of "Management's Handbook" into German for the benefit of German engineers and industrialists would be a step in promoting this acquaintanceship.

The needs of German manufacturing and industry today have been presented by E. Elmer Staub[1]:

> German industry is at the present time, with a few exceptions, working at capacity or close thereto. The larger portion of the product is, however, for home consumption, and if the cities and provinces secure loans of sufficient amount to undertake the extensions of public improvements and renewals of public service facilities which ought to be undertaken, a shortage of manufacturing labor would not be surprising. Capacity operations, the modernizing of equipment and lower taxes will reduce costs. Consolidations may also be looked for in a further effort to press down costs to a point where competition in the export field can be successfully met.
>
> America's concern has always been that Germany could produce cheaply because of very low wages. The German workman today receives approximately as many reichmarks as the American workman does dollars. From this it will be seen that the German labor-cost today would be about one-quarter that of the American labor-cost, if the individual efficiency were approximately identical.

In this effort to increase the efficiency, modernize equipment, improve methods in the face of increased wages, Germany turns to America for the knowledge of those methods which have been proved, tested and found successful. Under such conditions, what is wanted is recorded knowledge, classified for use and proved by experience to be worth while as a basis for future performance.

Dean Dexter S. Kimball[2] has declared that we have such a literature of management to offer:

> When Taylor wrote his great paper, there was little or no literature on the science of management, either in general or in detail. Since that time a prodigious amount of such literature has been issued. True, much of this literature has not been very valuable, and much of it has already passed into oblivion. But on the other hand, there has been much constructive writing, some of it in fields not touched upon by Taylor's paper. Without doubt, Taylor's prophecy that "many of the elements of management now believed to be outside the field of exact knowledge will soon be standardized, tabulated, accepted and used as are now many of the elements of engineering" has been fulfilled in a large measure.

While gratification is a natural feeling over this generous praise given to American management practice and literature, we must not overlook the possibility that general adoption of our methods in Europe may intensify our foreign competition. In any event, we cannot afford to cease our efforts to improve still further our own management.

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[1] MANAGEMENT AND ADMINISTRATION for April 1925, p. 323.
[2] MANAGEMENT AND ADMINISTRATION for February 1925, p. 113.

Westinghouse Shop Express System

Speeds Small Package Delivery with Big Cut in Transportation Cost

By STEWART M. LOWRY

Supervisor of Transportation, Westinghouse Electric and Manufacturing Company

READERS of the article on "Measuring the Efficiency of Shop Trucks,"[1] which appeared in the September 1924 issue of MANAGEMENT AND ADMINISTRATION, may recall the statement that a "shop express" system was being developed at the East Pittsburgh Works of the Westinghouse Electric and Manufacturing Company. The success of the plan, which has been in daily operation since its inauguration in August 1924, has greatly exceeded expectations, and it has been in operation sufficiently long apparently to justify the prediction for continued success.

The function of the shop express is to handle the delivery of small, miscellaneous, interdepartmental shipments that do not justify special trips by messengers, hand trucks or autotrucks. It is readily conceivable that, in a large plant like the main works of the Westinghouse Company, which normally employs over 20,000 people, there will be a large number of quick deliveries required in the course of a day. It is realized that some of these will necessitate special trips which cannot be avoided, on account of emergencies that are bound to occur in any manufacturing plant—emergencies that may halt production entirely for the lack of some essential part or material. In such cases, of course, it is justifiable to dispatch a messenger or truck on a special trip to the storeroom or department that supplies the material required. However, those cases are rare in which requirements cannot be anticipated at least the few hours necessary to telephone the order and have the material delivered by shop express, which operates on a schedule taking 4 hr. as the maximum delivery time. This delivery time, on the other hand, may be as short as 5 or 10 min., depending, of course, upon the relative locations of the departments sending and receiving the shipment.

Starting the Shop Express System

The need for some sort of shop express service had long been recognized, and when a plan was developed, it was laid before the heads of manufacturing departments both individually and collectively to determine the approximate amount of business that might be expected, and to decide on tentative locations for stations. When the plan was put into operation in the middle of August 1924, 57 stations were established throughout the works.

[1] By the same author.

Three routes were laid out, each of which embraced approximately 20 stations. One electric industrial autotruck, fitted with a special body, was assigned to each route, and scheduled to make four trips daily. The three routes met at a centrally located transfer station where material, which had been picked up on one route but consigned to a station on another route, was transferred to the proper truck. Each truck was operated by one man without a helper. Essentially these same arrangements have been maintained and have been found to work out very satisfactorily even under a greatly increased volume of business and the addition of more stations.

Advantages and Savings

This plan for handling small packages has many advantages over the methods formerly employed. Chief among the advantages are:

1. Reduction of hand trucking and messenger service.
2. Constant service that is always available.
3. Reduction of supervision and delays attendant to getting receipts signed.
4. Regular service to and from departments that do not have autotrucks of their own.
5. Less fractional loading of regularly assigned autotrucks, thus making it possible to use them to better advantage.
6. Reduced transportation costs per unit as the combined effect of the above advantages, which is, after all, the ultimate objective.

It will be understood, of course, that the importance of these advantages will be influenced to a great extent by the amount of business handled and the size and layout of the plant. Our East Pittsburgh Works, having over 100 acres of floor space, much of which is on the ground floor, practically covers a property which is nearly a mile long by one-seventh of a mile wide. It is readily apparent that a shop express system is of greater advantage in such a plant than it would be in a smaller plant where the manufacturing activities were more concentrated and contained in multi-story buildings in which elevator service was a much more important factor. This does not mean, however, that the plan could not be used effectively on a smaller scale by smaller concerns. The plan would be practically as effective in our plant if it were only

one-third its actual size, for then we would probably operate only one route instead of three.

Referring again to the advantages enumerated above, let us consider each of them in detail. Taking the first one, it is difficult, if not impossible, to determine accurately the extent to which hand trucking and mes-

FIG. 1 SHOP EXPRESS TABLE

One pan of incoming material is shown on the left, and outgoing material with shipping tags attached, on the right.

senger service are affected. In some departments the service supplied by the shop express has made it possible to dispense with one or more hand truckers entirely. These cases are few, however, as the effect in this respect generally is that only a part of a man's full time is saved, thus making it possible to employ him on other work for that portion of the time.

It is a safe estimate that the aggregate savings are the equivalent of perhaps a dozen hand truckers. In one particular department where a hand trucker was employed full time in delivering an average of from 25 to 30 small orders daily all over the shop, it was possible to dispense with his services entirely. The shop express is now handling that business, which represents less than 7 per cent of its total, at a cost of about $0.044 per package. On the basis of wages alone, the cost was nearly $0.15 per package under the old method. This saving is much greater in those departments that have fewer small miscellaneous shipments, and, of course, not so great in those that have more.

Constant Service

The advantage of constant and dependable service cannot be overlooked although there is no direct measure of it. Supervisors in the shop become familiar with the shop express schedules and know the amount of time to allow for delivery and, although the system is not infallible, they have a reasonable assurance that the material will reach its destination when they expect it to.

The extent to which supervision is reduced is also impossible to determine accurately, but this is undoubtedly one of the favorable results. Shipping material from one department to another by shop express is a simple, routine operation that any shop clerk can handle. No specific oral instructions to the trucker are necessary. The system provides the shipping department with evidence that the material was shipped by shop express, and it also provides the transportation department with evidence that the delivery was made to the proper place. After all, this is everything that is to be desired. The customary delays attendant to having the trucker bring back a signed receipt from the department receiving the material, as is done when the shipment is made in any way except by shop express, are entirely eliminated. This simplification is no small item when it is difficult to locate a supervisor in the receiving department to sign for the material. A reduction in delays and in the demands upon the supervisor's time and attention are thereby effected at both ends.

Service to Small Departments

Ordinarily, autotrucks are assigned to the departments requiring them, but there are a number of small departments whose trucking requirements are very

FIG. 2 SHOP EXPRESS TRUCK, SHOWING SPECIALLY DESIGNED BODY

limited and very irregular, so that it does not pay to assign an autotruck regularly to each of them, considering the limited extent to which it would be employed. However, when an autotruck is needed, such a department is handicapped on account of the difficulty of borrowing one from another department or in some other way finding transportation facilities. The shop express does not fully solve this problem, but it helps to relieve the situation by providing regular autotruck service to those departments, and they can make use of it to the extent of its capacity.

One of the chief reasons for organizing a shop express grew out of the continual observation that an electric

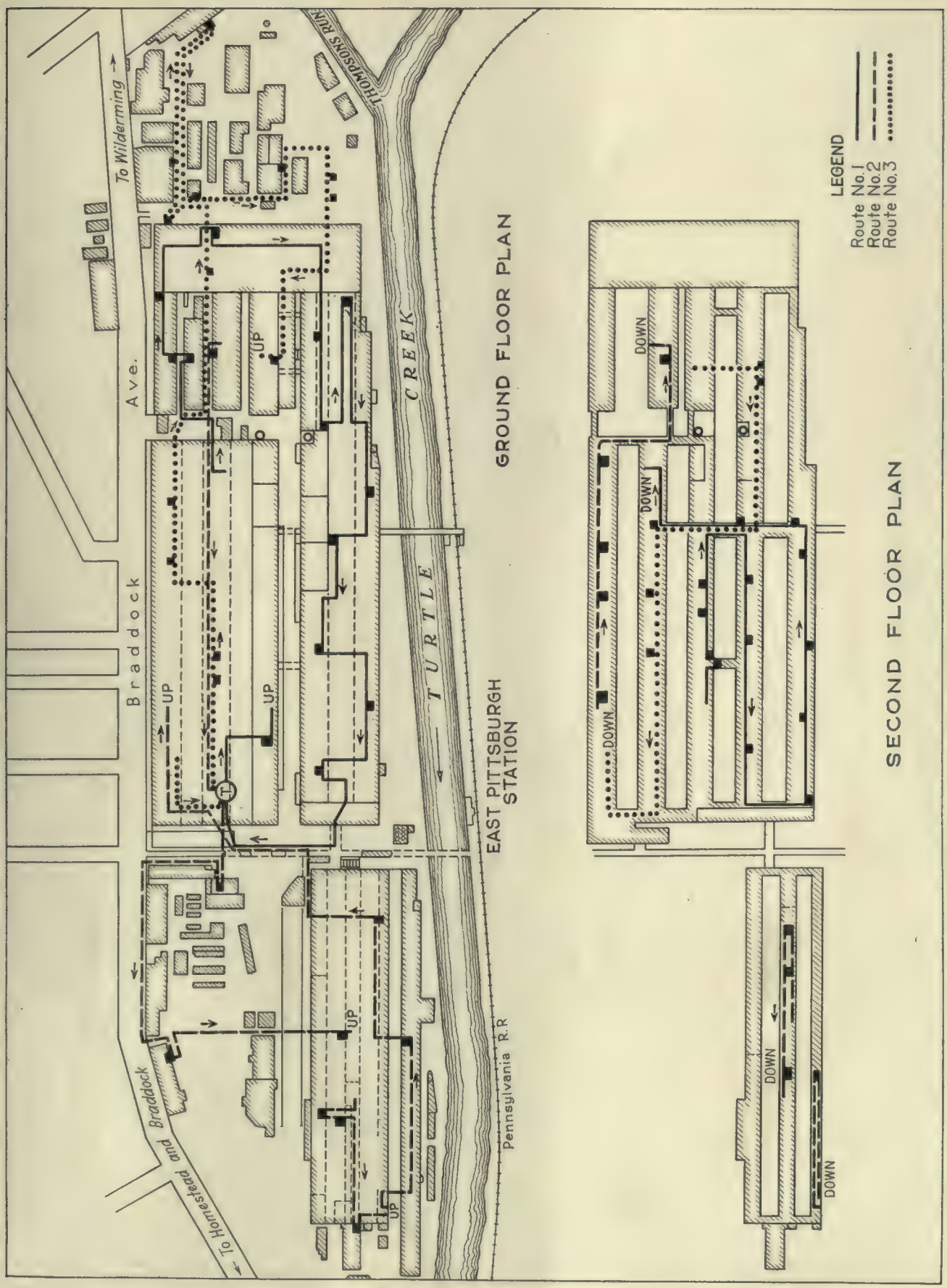

FIG. 3 LAYOUT OF WESTINGHOUSE PLANT, SHOWING THE THREE SHOP EXPRESS ROUTES, INDIVIDUAL STATIONS (BLACK SQUARES) AND TRANSFER STATION "T"

autotruck was frequently being used to deliver a small parcel or box from one part of the shop to another, which indicated inefficient use of autotruck equipment. Trucks that are capable of carrying a load of 4000 lb. obviously should not be used to deliver a parcel or box weighing 100 lb. or less, if it can be avoided.

From studies on representative autotrucks covering a total of 418 trips, it was found that on 147, or 35.2 per cent, of the trips, the truck was empty, and on the remaining 271 trips the load varied from full load down to one package or small unit. The average length of each study was slightly more than a day. As a point of explanation, a "trip" was taken to mean the distance from one stop to the next. Thus, a truck may have made several "trips"—one more than the number of stops—from the time it left its headquarters until it returned again after completing a circuit to other departments. The empty trips were generally return trips from delivery points. Of the 271 trips that might be termed "loaded trips," the average size of load was less than 60 per cent of the capacity of the truck. Including the empty trips in the total of 418, the average size of load was only 38 per cent of capacity. The average number of trips per day for each truck was 47.

Number of Express Trucks Needed

Of the 271 loaded trips, 39 were loaded to only one eighth capacity or less. This represented 14.4 per cent or an average of five such trips daily for each truck. Carrying out this ratio for our then entire fleet of 75 trucks, there was indicated an aggregate of 375 such trips daily, or enough business for seven express trucks, provided all small shipments could be segregated and handled in this way, and provided the service was conscientiously used by the shop supervisors. It was realized that all of this business could not be diverted to a shop express, so the plan was started with three trucks instead of the seven which the estimates indicated could be employed. The probable business that would be diverted from hand trucks and messengers was not included in the above estimates. Actual results have justified the belief that fractional loading of autotrucks would be reduced even though this has not been realized to the full extent estimated. The hand truck and messenger business secured, however, greatly offset this discrepancy.

As for reduced transportation costs, which is the last mentioned of the enumerated advantages, wherever it has been possible to compare directly the old costs with the present ones, everything is in favor of the shop express. It is assumed, then, that this holds true also for those cases where previous costs are not available. A full analysis of shop express operating costs will be presented in a later article.

The special equipment employed in operating the shop express is not elaborate. After deciding upon the number and locations of the stations, tables of a special design, as illustrated in Fig. 1, were built and installed at the various station locations. These tables are about 6 ft. long by 2½ ft. wide and 18 in. in height, and they are used exclusively for shop express material. It will be observed in the photograph that the top of the table is divided into two sections by means of a low strip of wood across the middle. One side is for outgoing material and the other for incoming material. In the drawer is kept a supply of shop express shipping tags, which is replenished when necessary by the driver. Each station is numbered, and in the table drawer is kept a rubber stamp bearing the station number, the purpose of which will be described in a subsequent article.

After some experimenting, the special body illustrated in Fig. 2 was developed, and has been found quite satisfactory. It is made of wood in order to keep the weight at a minimum. Joints are mortised and the corners and other parts which are subjected to bumps are made of hardwood, whereas the unexposed and protected parts are made of lighter and softer wood. The bin sizes and arrangement are the outgrowth of studying the various packages and kinds of material handled. A number of bins on the left-hand side have been designed especially to accommodate our standard 24 in. by 12 in. by 6 in. tote pan. A special bin with a door and lock is provided for expensive tools and other similar material.

It is not necessary to have a particularly high-grade man to operate a shop express truck, although the requirements of the job are somewhat higher than those of an ordinary trucking job. He must be able to read and write and speak English, and he should have some judgment. He must be thoroughly familiar with the layout of the plant and the locations of the various departments. He must be able to recognize whether shipping rules have been complied with, and he must know how various kinds of material should be handled to prevent damage. He should be courteous and intelligent, so as to keep the good will of the shop supervisors. The shop express driver should be a man who will work conscientiously without close observation.

Extent of Service and Layout of Routes

As this is being written, there are 67 active shop express stations extending service to no less than 206 manufacturing departments, storerooms, and warehouses. Some of these departments rarely make use of the service and others do not use it at all, but it is available for all of them. In many cases, one station serves a number of departments in the vicinity.

It has been necessary to revise the original layout of routes several times. This was to be expected. A number of the original stations have been discontinued because the anticipated business was not forthcoming. Likewise, a number of new stations have been added at the request of the respective department heads. Every effort is made to comply with such requests if prospective business seems to justify establishing a station. Fig. 3 is a floor plan of the East Pittsburgh Works showing the present arrangement of the three shop express routes.

(To be concluded in the August issue.)

Practical Results of Budgeting

Accuracy of Budget So High That Improvements in Operation Can Be Started Without Waiting for Final Records

By RALPH H. ALLEN

Assistant Treasurer, Thomas A. Edison, Inc.

A PRECEDING article[1] gave general instructions covering budget control and some of the methods which have been found satisfactory in budget building. This article gives a few more of these detail methods and evaluates the usefulness of the budget through statements of the operating executives. The details of methods start with the sales budget.

The Sales Budget

The sales manager's schedule of sales, in form similar to Table 5, is as accurate as he can possibly make it, considering:

1. Past performances.
2. Seasonal fluctuations.
3. Consumption capacity of the country.
4. National and sectional business conditions.
5. Competition.
6. Obsolescence of the product.
7. Selling prices.
8. Manufacturing limitations.
9. Shipping limitations.
10. Unfilled orders.

The credit manager's forecast should indicate the probable cash collections as well as the segregation of notes and accounts receivable as at the end of the month. The credit manager's forecast and the treasurer's budget should, of course, dovetail with respect to collections.

The factory manager's forecast should note the probable segregation of the inventories into raw materials, merchandise in process, and finished merchandise.

Determining the Objective

For accurate forecasting, every department of the organization must be represented. The advantages accruing from the co-ordination of all departments to a given financial program and the interchange of ideas this involves, while invaluable in themselves, are merely collateral to the greater good that comes from searching for and finding the answer to the important question: "Where are we heading?"

The individual forecasts are now ready for assembly on the balance-sheet-profit-and-loss statement.

The elements analyzed, roughly speaking, correspond to the books of original entry, cash book and journals. They are:

Sales	Journal transfers
Collections	Income from investments
Disbursements	Pay-roll
Pay-rolls	Income tax reserve
Others	Plant reserves
Purchases	Miscellaneous

The above are analyzed into the component items of a condensed balance sheet, which, for purposes of demonstration, are assumed to be as follows:

Cash	Investments
Receivables	Working capital
Inventory	Plant
Deferred charges	Plant reserves
Notes payable, banks	Bonds
Other payables	Capital
Accruals	Surplus

As all the transactions of a business are first entered in the books of original entry, the ledgers being used merely to analyze and classify into various accounts the activities of the period, bookkeeping principles are followed in our method of forecasting, the accounts on the balance-sheet-profit-and-loss statement correspond to the accounts of the ledger when the books are closed, though kept in columnar form instead of the usual ledger form. (See Tables 2[2] and 6.)

Thus, the Cash column is a synopsis of the Cash account, the Surplus column a synopsis of the Profit and Loss account, etc. The treasurer's estimate is posted opposite Collections and Disbursements into the accounts affected, cash expenditures for expense items being posted direct to the Surplus column.

Likewise, the purchasing agent's estimate of purchases to be made is posted opposite Purchases. Materials, factory supplies, etc., are charged to Inventory; equipment purchases to Plant; advertising and other expense items to Surplus.

The only item requiring special treatment is Sales. The factory cost of sales must be established, and the

[1] See MANAGEMENT AND ADMINISTRATION, June 1925, pp. 527-530.

[2] In the June issue, p. 529.

percentage of gross profit found. It must be recognized that, due to abnormal conditions, this percentage may vary considerably. Any variation should be discussed during the conferences referred to above.

In the balance-sheet-profit-and-loss statement shown in Table 2, we have considered for the sake of simplicity that the gross profit on sales is 30 per cent.

In the following example the general sales manager forecasts his sales for the month at $1,000,000. The entry on the forecasting form will be:

Charge Receivables	$1,000,000
Credit Inventory (factory cost)	700,000
Charge Working Capital	$300,000
Credit Surplus (gross profit)	300,000

The percentage of gross profit and factory-door cost of sales should be verified periodically and any marked changes brought to the attention of the conference.

Journal Transfers

The journal transfers are merely those monthly entries usually made before completing the financial statements of the business. For the purpose of illustration the following are included:

Income from Investments. The amount of income accrued is charged to Deferred Charges account and Working Capital and credited to Surplus account.

Pay-roll. The amount of factory pay-roll accrued, both direct and indirect labor, being part of the product, is charged to Inventory account, while the administrative and selling pay-roll is charged to Surplus account and credited to Working Capital. The total pay-roll is credited to Accruals.

Income Tax Reserve. The amount of accrued income tax for the month is entered here.

Plant Reserves. That portion of the reserves for depreciation of buildings, and equipment covering factory operations is charged to Inventory account, the balance being charged to Surplus. These amounts can be closely estimated due to their constant recurrence.

Miscellaneous. Miscellaneous journal transfers cover the monthly amortization of prepaid insurance and interest charges, accruals for royalties, commissions, etc., and any other items not specified above.

A Total Indicates Forecasted Changes

A total of the columns of the balance-sheet-profit-and-loss statement indicates the forecasted changes in the assets and liabilities for the period.

For balance sheet purposes it will be found necessary to segregate items forecasted in totals, such as receivables, inventory, etc.

By posting the balance sheet items as at the beginning of the month and adding the total monthly fluctuation as developed by the balance-sheet-profit-and-loss statement, the forecasted result is obtained in a comparative form with the differences noted.

Obviously there should be agreement between the sales manager's schedule of sales, the factory manager's schedule of manufacturing, the purchases, collections, etc. In spite of co-operative meetings and conferences of department heads, however, differences are apt to disclose themselves which are readily apparent when the figures are co-ordinated in the balance-sheet-profit-and-loss statement. The correction of these discrepancies naturally follows, and is another means of executive control.

Presumably, business managers have often said to themselves—"If I only knew how I was coming out from day to day, how much better off I would be as compared with waiting so long before receiving my statements; that is, if I could close daily, like a bank."

TABLE 5. SALES DEPARTMENT—ESTIMATE OF SALES
Month of May 1925
(Dollars in Thousands)

PRODUCT	UNFILLED ORDERS TO BE SHIPPED MAY 1925	EXPECTED ORDERS MAY 1925	TOTAL	EXPECT TO SHIP MAY 1925
A	150	75	225	175
B	200	250	450	325
C	50	40	90	75
D	35	10	45	40
E	45	100	145	80
F	90	125	215	125
G	130	200	330	180
etc.	.....	.....	.....	.....
Total	700	800	1,500	1,000

While the Edison Industries have not found it necessary to use the daily financial closing, it is entirely feasible to do so with the balance-sheet-profit-and-loss statement. In the Edison Industries the forecasting of the conditions of the business at the end of the current month is made three times: First, on the 10th, revised on the 20th, and again revised on the last day of the month. In times of rapid rise or fall in prices, overnight changes in business conditions, a special forecast is prepared, so that the effect on the Edison business is immediately determined.

If there is one thing which pleases the officers of a creditor bank, it must be to know that the enterprise to which it may have loaned money is in daily touch with its business. A tangible evidence of this is where the bank received a balance sheet in the incoming mail on the first of the month showing the forecasted condition as at the close of business the day previous.

The following statements made by Edison executives explain briefly, in a practical way, how each has made use of the business forecast in improving the business:

"There is no matter of more importance in business than the conservation and control of cash. Experienced business executives often state, axiomatically, that it is easier to earn money than to save it. Just what dividends care and exactitude in the handling of cash will pay depends on the completeness of the cash control.

"It is also obviously advantageous for all businesses, but particularly those of a seasonal nature, and those that have to accumulate goods for future sale, to be able to anticipate their financial requirements.

"To sum up the whole matter, every business operation, in the last analysis, affects cash. A procedure,

then, which results in conserving cash resources, the better controlling of cash income and outgo, and the forecasting in advance of cash position is obviously of vital importance to the proper conduct of any business. All this can be accomplished by means of the budget."[3]

The percentage of accuracy of the Edison cash budgets has been so high that it has been found practicable to use them at all times as the basis of the financial program, thus permitting us to execute and accomplish the necessary steps in improving the business many days in advance of any company which has to wait until its final records are compiled before taking action.

Edison Storage Battery Business

"Each salesman and district office is held rigidly to its sales budget. An example of one of the bulletins used effecting this condition appears below:

Sales and Service Bulletin *April 20th, 1925*

"THE SALES BUDGET 1925-26

"The latter part of January each district office sent in its sales budget for approval. Each salesman in each district pledged to Mr. Edison, through the district manager, that he will sell during this new fiscal year a given number of A-4 equivalents and, based upon that pledge, Mr. Edison has approved the sales budget. He has taken each of us at our word. In other words, he has taken what we have told him at face value. By the approval of your sales budget he has shown that he has confidence in us, and attached to this confidence is a tremendous responsibility.

"Now is the time for you and me to put forth every possible effort to maintain this confidence and keep the pledge. It is not a question of working as hard as we can. It is necessary to get orders. When we work as hard as we can and we are not getting orders, it indicates that we are not spending our time to best advantage.

"A common denominator is used in our business known as the A-4 equivalent, which means that we produce a cell known as an A-4 cell, and that any other cell may, by computation, be reduced to the basis of an A-4 cell. Each salesman is given a mark to reach, not only as to number of cells he must sell, but also as to the selling expense per cell. If his selling expense per cell is less than the budget figure set he receives a bonus based upon the difference. The plan is carried out on an annual basis.

"Edison storage batteries are cells in which electrical energy is stored until required for use. The Edison battery differs radically from the ordinary lead acid type battery, both in construction and chemical reactions. It is constructed entirely of steel, the active materials being held securely in perforated steel tubes and pockets and welded in a steel container. The electrolyte is an alkaline solution (a preservative of metal) instead of an acid.

"The long life and economy of the Edison battery is due to its rugged steel construction, light weight and the fact that its chemical processes are completely reversible, and, therefore, theoretically, cannot be exhausted or deteriorated by charge or discharge. No definite life for an Edison battery can yet be stated for all services. In many installations the Edison batteries are still over 100 per cent rated capacity after 13 years' of hard and continuous service."[4]

[3] From "Business Forecasting in the Edison Industries," under "Cash Conservation by Means of the Budget," by Harry F. Miller, Treasurer.

TABLE 6. COMPARATIVE BALANCE SHEET*

	MAY	APR.	MAR.	FEB.	JAN.
Cash	245	503			
Notes Receivable	250	185			
Accounts Receivable	1,047	962			
Raw Material	868	826			
Merchandise in Process	800	900			
Finished Stock	1,220	1,220			
Deferred Charges	29	27			
Total	4,459	4,623			
Notes Payable, Banks	900	1,000			
Accounts Payable	630	725			
Accruals	73	12			
Income Tax Reserve	108	100			
Total	1,711	1,837			
Working Capital (Difference of above totals	2,748	2,786			
nvestments	200	200			
Total Working Capital	2,948	2,986			
Land	50	50			
Buildings	420	420			
Reserve	*107*	*105*			
Equipment	770	765			
Reserve	*226*	*218*			
Total Plant	907	912			
Bonds	400	500			
Total Capital	3,455	3,398			
CAPITAL:					
Capital Stock Preferred	1,000	1,000			
Capital Stock Common	1,500	1,500			
Surplus	955	898			
	3,455	3,398			

* Columns for last half of year are omitted here.

Cement

"The results of our budget comparison are very satisfactory for the calendar year 1924. Actual cost of cement in bins per barrel was 99½ per cent correct, production 95 per cent, sales 96 and profits 92.

"Our budget has provided a basis for working out in advance a policy as to sales, production and expansion, and also furnished a goal which every department has been keyed up to attain.

"Thomas A. Edison was one of the pioneers in the cement industry, inventing apparatus that revolutionized the manufacture of cement in this country. He has worked untiringly, and has succeeded in putting a product on the market which is above specifications."[5]

[4] G. E. Stringfellow, Vice-President and General Manager, Edison Storage Battery Company.

[5] W. D. Cloos, Vice-President and General Manager, Edison Portland Cement Company.

The budget for the primary battery business last year "was 97 per cent correct as to sales, and 98 per cent correct as to profits. In manufacturing to a predetermined budget or schedule of production we have been able to standardize our prices, product and costs. In selling, our district managers have, by eternal striving towards the budget-objective set for them, secured a volume of business in excess of any previously done by this business. By co-ordinating the manufacturing and selling budgets with a financial budget, a balanced system of executive control has been developed which is enabling us not only to increase the business in present uses, but to extend the product to new uses.

"Edison Primary Batteries, as you know, are small independent, electric power plants, which produce their own energy without charging from other power sources, and give it up, as required, at uniform voltage, for their pre-determined life. They are largely used for the operation of automatic signals and related devices on railroads, for highway, traffic and other signals using low-voltage, flashing electric lights, in telephone and telegraph work, fire and burglar alarm systems, motor boat ignition, program clock systems, electric time stamps, etc."[6]

Ediphone

"Last year our budget of sales was 94 per cent correct, and our budget of profits 93 per cent correct.

"By knowing where we are going we are able to make arrangements in advance, thus giving us the advantage over the hand-to-mouth enterprise.

"The Ediphone is successful because, like the telephone, it aids the executive to gain time for getting action. The executive can dictate when he likes, day or night, with no thought of the availability of some other person. It gives him independence.

"The stenographer does not write her letters twice—once in a note book and again on the typewriter. Therefore, because the Ediphone doubles her production capacity, the stenographer makes greater personal progress and is more valuable to her employer."[7]

Phonograph Business

As long as production is based upon the "hunch" of some executive who grandly guesses the probable sales, the outcome of business is extremely doubtful. The "hunch" method of doing business that was popular in the days of '49 has disappeared from modern enterprise to a large extent. This is particularly true of the Edison phonograph business. The management knows with reasonable accuracy the volume of its products being purchased by the ultimate consumer, the public, so that it is in a position not only to avoid clogging its channels of distribution, but to forecast the trend of its business.

Thomas A. Edison's favorite invention is the phonograph. It has been perfected to the point where its reproduction of music stands the acid test of comparison with the living artist. The reality of this achievement has been established beyond all doubt by public tests in practically every large city on this continent.

[6] L. W. McChesney, Vice-President and Manager, Primary Battery Business, Thomas A. Edison Industries.

[7] Nelson C. Durand, Vice-President and General Manager, Ediphone Division, Thomas A. Edison Industries.

Simplification and Fair Trade Practice

BULLETIN No. 35 of the Department of Manufacture, Chamber of Commerce of the United States, calls attention to the fact that the curing of trade evils, some of them bordering on unfair trade practice, was not thought of when the war on waste through elimination started, but has come about as a natural and beneficial development.

The manner in which these trade practices are being eliminated may be best told in the words of those engaging in the particular industries, and the following statements are verbatim expressions from manufacturers in the lines indicated.

Sheet Steel. If we go back to the years 1900 to 1905, we find that from 15 to 20 per cent of the entire sheet production of the country was sold in one or more of the popular forms of roofing. While true that other industries consuming sheets have developed during this period to an extent which enables them to consume from 30 to 40 per cent of the sheet production, the roofing industry has stepped steadily backward, and we find today that instead of taking at least 15 per cent, less than 6 per cent is sold as roofing. Twenty years ago no. 26 gage was the general standard for roofing purposes. About five years ago, competition had placed the standard at 29 gage, this gage weighing 11½ oz. per square foot. The mills then began to receive requests to roll their sheets for roofing purposes to 11¼ oz. per square foot.

The unfortunate feature connected with such light sheets is that the lighter the base metal, the lighter is the coating. No. 24 gage has a real substantial body of base metal, but as the gages grow lighter, the coating which is taken on also grows lighter, with the result that there is but little protection from the galvanizing on no. 29 gage. Within the past few months, the sheet steel industry or, to be specific, 29 sheet manufacturers have launched a trade extension campaign. One of its principal objects is to educate the buyer and teach him the service of sheet steel in the proper gages for proper purposes. The simplification schedule provides for the elimination of all sheets for roofing purposes lighter than 28 gage.

Metal Lath. Changing the specifications of metal lath from gage to weight per unit (square yard) has done the metal lath industry worlds of good. Under the old method of specifying metal lath by gage, unscrupulous manufacturers, in case of severe competition, could easily enlarge their openings, thereby reducing the weight of steel in a square yard of material. The present method of specifying by weight per square yard eliminates this practice.

Definite and practical service to aid industries in their industrial waste surveys has been built up by the Department working with the Secretary of Commerce.

New Worthington Tool-Crib Service Operates with Satisfaction

By ANKER L. CHRISTENSEN

Engineer, Tool and Material Storage Department, Worthington Pump and Machinery Corporation

TOOL issuing is the major duty of the tool crib, and one of the vital functions of factory operation. This function should be kept up to a high standard of efficiency.[1] The following is a general set of conditions which should be satisfied in order that tool crib service may be worthy of the name:

1. Careful, accurate and rapid service should be maintained at all times. The tool crib attendant should have tact, and the ability to interpret quickly the poorly described requirements of the workman and hand him a perfectly conditioned tool with the least possible delay.
2. The location of tools, as well as the party who is responsible for them when they are not in the crib, should be known at all times.
3. Every effort should be made to insure that the workmen really get the tools they need. Conversely, tools should not be issued to men who have no use for them.
4. Any breakage should be promptly checked up and charged to the proper account. Undue breakage should be abated without delay or argument.
5. Tools that are charged to the workmen should be checked up frequently.
6. Unnecessary or unused tools should not be allowed to accumulate in the workmen's possession.
7. The tool crib attendants, to carry out the above rules, should be chosen carefully. They should have a well-developed appreciation of responsibility, and be familiar with tools and their trade-names. They should be courteous, accurate and obedient. Anyone who has these qualifications may learn to disburse tools in a short time.
8. The necessary records should be as simple as possible.
9. Records should be so devised that the workmen have as little writing to do as possible.
10. The more complicated operation of record keeping should be done by a clerk competent to handle that kind of work.

The method of issuing tools depends upon the kinds of tools used as well as the nature of the manufacturing process, and whether or not the factory is on a jobbing or production basis. The following is a more detailed description of some of the common systems now in use:

The Single Brass Check System. The principle of this system is simple. The workmen are given a number of brass checks marked with their pay-roll numbers. These tags are generally charged to them at a certain specified value (about $0.25 or $0.50). When a workman requires a tool, he exchanges one of his brass checks for it, and the crib attendant hangs the check on the bin hook. As soon as the workman brings back the tool in good condition, the attendant returns his check to him and the transaction is complete.

While this single brass check method is the simplest one in use and entails no loss of time for record taking, it has not been found practical, especially where expensive small tools are used, for the following reasons:

1. Checks get knocked off hooks, and if the crib attendants do not see which hooks the checks came from, they have no exact means of knowing where the checks belong.
2. Checks are sometimes placed on the wrong hooks.
3. If a workman is unscrupulous, he can take advantage of the weak points in the system, and "acquire" gradually a set of tools for himself.[2]

The fact that checks are sometimes misplaced, and at other times fall off the hooks, lessens the crib attendant's assurance that other checks are in their right places. Suppose a workman draws out an expensive tool on his check, and in a few days returns another tool and demands his check. Of course the crib attendant cannot find a check on the bin hook of the tool which has been returned; but the workman insists that he gave his check for it, and the very fact that he has the tool in his possession may be taken as proof that the check has been lost or misplaced. Also, when leaving a company, men sometimes sell their checks to others in the factory, and say they are lost. They are charged $0.50 for each lost check and released. Later, when the opportunity is ripe, the man to whom the checks were sold can turn in these checks and request tools that he desires to keep for himself. Such tools may be smuggled out and the company has no means of tracing them.

There are places—such as jig and fixture cribs,

[1] See MANAGEMENT AND ADMINISTRATION, May 1925, pp. 467-470, and June 1925, pp. 537-540, for previous articles on Worthington tool storage methods.

[2] See *Industrial Management*, January 1922, pp. 24-25, "Beating the Brass Check," by F. A. Sharp.

TOOL LIST	OPERATION SYMBOL	
Mach. No. 1055	Patt. No. IN 95	Draw. No. DR 39651

Tools Called for on this Tool List Must Be Issued in a Tote Box. The List Should Be Placed in the Tag Pocket on the Box Accompanying the Tools To and From Machine.

Sz. ¾ x 2	Sz.	Sz. ¾
Sy. CBSS	Sy. CHK	Sy. CHWW
No. 2	No. 1	No. 2
Sz. ¾	Sz. IN 95 DR 39651	Sz. 2 x 38
Sy. CNH	Sy. JRMDS	Sy. RHAMP
No. 2	No. 1	No. 1
Sz. 2 x 32	Sz. 6 x 2¾ x 2	Sz.
Sy. RHB	Sy. RPSP	Sy.

When the tool list is not correct the Gang Boss must at once report the error to the man who signed this list.

Mon.	Day	Year	Man	Signed

FIG. 8 TOOL LIST FOR STANDARDIZED JOBS

where the tools are few in number, large in size, and not tempting for the men to carry home—where this method will work to advantage. But in general, the single brass check system is unsatisfactory.

Double Brass Check System. With this system, as with that of the single brass check, each man is given a certain number of brass checks bearing his pay-roll number. In addition, each tool has a metal tag called the tool symbol check. This symbol check is marked with an exact duplicate of the marking on the tool. These checks are hung on the bin hooks of the various tools, while a board is provided with a hook for each workman in the shop.

To issue a tool with the double brass check system, the tool crib attendant replaces the tool symbol check with the man's tool check, gives the tool to the man, and hangs the tool symbol check on the hook bearing the man's number. When the tool is returned, the workman is given his check, and the tool, with its corresponding check, is returned to its proper place.

For simplicity and durability, this system is all that could be asked for. It affords a means for cross-checking, in that by looking at the man's check hook on the control board, the number of tools that he has out is easily determined.

There are, however, some disadvantages to be contended with, such as:

1. Checks fall from the hooks and are misplaced by the crib attendant, since it is practically impossible for him to know where they belong.
2. It is difficult to tell how long a tool has been out.
3. Men often require more tools on a job than they have checks to exchange for them.

McCaskey System. The principle of this system is that all tools should be issued only by written forms. By an arrangement of carbon-backed forms, three copies are made at one writing, each on a different color of paper.

The mechanical equipment consists of a series of metal leaves fitted with a number of spring clips, and fastened together like a book. These leaves are assembled in a box-like cabinet. A clip is reserved for each workman, and a tag in the middle of the clip is marked with the man's name and pay-roll number. A clip is also reserved for every individual tool in the crib.

When a workman wishes to draw a tool, he makes out one of the tool issue slips in triplicate. This is given to the tool crib attendant who puts one copy under the clip corresponding to the man's number and one under the tool number in the cabinet. The third copy is given to the man with the tool to serve as his record of the tool that he is responsible for. Upon return of the tool to the crib, the slips are removed from their respective clips in the cabinet and destroyed. The advantages of this system are:

1. All tools that are in possession of a workman can be quickly and accurately determined.
2. The location of any particular tool may be ascertained promptly.

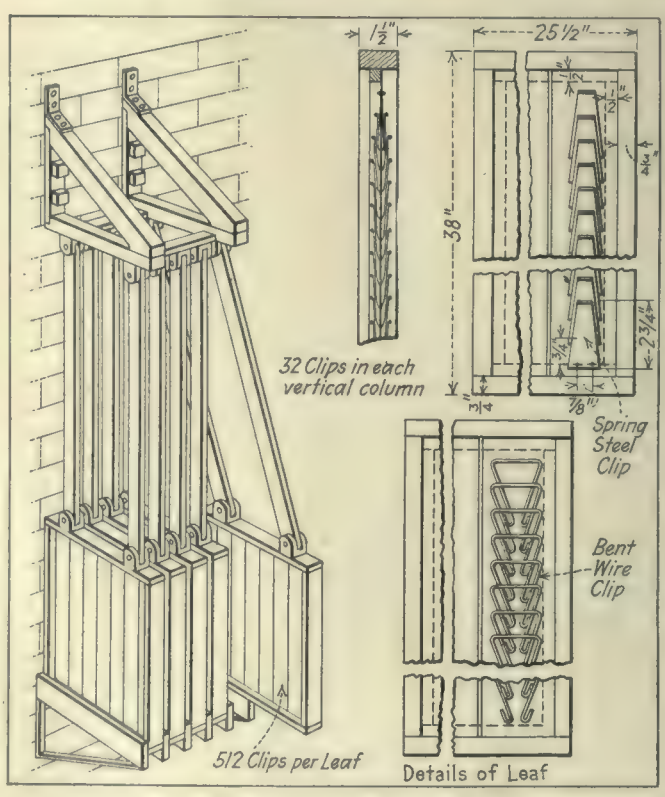

FIG. 9 TOOL ISSUE RECORD BOARD

3. Positive proof exists that tools were given to the workman.
4. Misplaced slips can be returned to their proper places readily.
5. It is almost impossible for men to misappropriate tools under this system.

So much for the issue system, where men go for and return their tools to the tool crib. A well-developed management system, however, relieves the workman of this duty by delivering a complete set of tools to each man in ample time for him to study the next job before the present one is finished, and by returning these tools to the storage room after completion of the job.

TOOL ORDER		Date
Workman's No.		
Quantity	Size	Symbol
Kind of Tool		
This tool is in your charge until returned. If lost it will be charged to you.		
Sign Here_____		

FIG. 10 ORDER FOR INDIVIDUAL TOOLS

Tool lists are made up giving an itemized list of all the tools necessary to perform given operations on given machines to suit given drawings. (See Fig. 8.) The tools on these lists are put into tool boxes and delivered to the machines where the work is to be performed. If a brass check system is in force, a sufficient number (indicated on list) of the man's checks are sent along with each list to exchange for the tools required. As the tool room attendant fills the set, he places the man's checks on the bin hooks as the tools are taken off. At the same time he removes the tool symbol checks and hangs them on the man's hook on the control board. One copy of the tool list is sent along with the tool set. This must be kept with the set and returned to the crib when the job is finished. The tools are then inspected and put away, while the man's checks are sent back to him and the tool symbol checks returned to their respective tool hooks.

At the Worthington Works a written record system is used in connection with the tool lists, in place of brass checks. Tool control boards (see Fig. 9) have been built and installed for the operation of the plan. These boards conserve space and get rid of the disadvantages attending check hooks. The installation, in a space 25 in. wide and 10 ft. long, holds a complete record of 40,000 tool items, or 4000 items per ft. width. There is a clip for each man and each tool.

Standard Tool Lists

The standard tool list forms have been arranged so that they can be used for cross-checking purposes. (See Fig. 8.) They are sent to the tool crib in triplicate when a set of tools is needed. The tool crib attendant takes one of the forms and stamps each of the sections with the date, the order number and the man's number. Then, with a paper trimmer, he cuts this form into individual slips calling for one tool each. These are placed in the individual tool board clips when tools are removed from the bin. The errand boy who delivers the tool sets will get the workman's signature on one of the copies, which is filed under the man's number until the tools are returned. The third copy remains with the tools, and must be returned with them when the job is finished. With the returned list as a guide, it is only a matter of a minute or two to remove the symbol slips from the tool board.

In case extra tools are needed, a form such as shown in Fig. 10 is used. The original is put in the man's tool clip and the duplicate in the tool clip for the specific tool it represents. When the tool is returned to the crib, the tool crib attendant has only to go to the workman's clip and remove the original slip. The value of the slip is destroyed by tearing off the part that has the signature, returning the latter to the man. The top portion is laid aside and used as a guide to remove the duplicates from the tool clips at a time when no men are at the window.

This style of cabinet may be closed and locked, thereby assuring that all records are kept safe. The compactness and simplicity of the cabinet puts the whole control arrangement in a very small space, and the man who needs 20 tools can be served as easily as the one who needs only one or two.

The work of making up tool lists may be done either by the routing and rating department (where one exists), or by creating a new department for that purpose. The former plan is the more practical, as there will already exist in that department a vast amount of information on machine performances, speeds and feeds, and tool set-ups.

SPECIAL LIST OF TOOLS CHARGED TO WORKMAN KIT NO. 102

Each workman is provided with a locker or closet in which to lock up the tools charged to him. Other tools needed can be obtained from tool room on leaving a number check as a receipt. All tools out on check must be returned immediately after they have been used. All damage or loss of tools will be charged to owner of check held as receipt, unless such damage or loss is proved to have been unavoidable.

	Pieces 1	Name 2	Size 3	Tool Symbol 4	Price 5
WORTHINGTON WORKS, HARRISON, N. J.	3	Flat Cold Chisels	¾"	HCMC	$1 75
	3	Rd. Nose Chisels	¾"	HCMR	1 75
	3	Cape "	¾"	HCMP	1.75
	1	Stilson Wrenches	10"	WPS	2.25
	1	" "	14"	WPS	3.25
	1	" "	18"	WPS	4 75
	2	Open End "	½" & ⅝"	WEHP	.65
	2	" " "	¾" & ⅞"	WEHP	.40
	1	Center Punch		HPCK	.10
	1	Flat Bastard Files	12"	AFBRF	.75
	1	Round " "	½"	AFBRR	.50
	1	Scraper		ARF	.30
WORTHINGTON PUMP	1	Pipe Pliers	8"	BSHWP	1.00
	1	Plumb Bob	5 oz.	MUB	.50
	1	Spirit Level	1"	MLMP	.50
	1	Dividers	10"	MDU	1.25
	1	Tin Snips	10"	BSHSTS	3.25
	1	Compass Saw	12"	SM	.40
	12	Checks	No. 176		3.00

I have received the tools listed above and agree to be held responsible for the care and safe keeping of same.

Signed John Jones 6

Month	Day	Year
3	13	24

Workman's No. 201 Y 7

Locker No. 101 8

FIG. 11 TOOL LIST FOR SPECIAL KITS

Considerable time is required in making up standard

tool lists for all operations in a factory. Lists for the standard products should be made up first. This can be accomplished by attacking one kind of product at a time, in the order of importance. Departments that function independent of other departments can be taken care of at convenient times. Job work that occurs at infrequent intervals should be left until the standard products are all taken care of.

Instruction forms should be made up, to accompany the tool sets, giving a complete description of how each tool is to be set and used, together with the speeds and feeds that are to be maintained.

So far, only tools that are returned after each particular job have been discussed. There are, however, many tools that are not returned to the crib after each operation. Generally, tools that are permanently issued to the men are charged as a tool kit.

A study of the various tool kits used will now be made. For convenience, they are grouped as:

1. Standard. Made up for machine operations, as described above and contain in detail all the tools necessary to perform a certain operation on a given machine to a given drawing. These tools must all be returned to the tool crib upon completion of the operation.
2. General. Tools which every mechanic needs, such as hammers, wrenches, screw drivers, etc.
3. Special.
4. Outside erection tool boxes.

General Tool Lists. There are some tools that every mechanic uses constantly. Obviously, it would be a waste of time to turn these in to the crib after using them each day. A general tool list has been made up, which contains tools that every mechanic should have in his possession permanently, such as oil cans, hammers, screw drivers, wrenches, file cards, etc. The price for each item is given on the list. In this way the workman knows exactly what he is responsible for. Spaces for additional tools are provided, and any tools on the list that are not needed can be scratched off in individual cases.

Tool Kits for Specific Jobs

Special Tool Kits. These kits contain the sets of tools that special workmen need and are constantly using in the performance of some specific job. It would be impracticable to have men, such as millwrights, plumbers, and erectors in the shop carry their tool kits on checks or individual issue slips. A kit of tools that will fill the general needs of each man according to the work that he is doing should be made up for electricians, assemblers, millwrights, chippers, testers, tin smiths, etc. (See Fig. 11.) The general tools that are used by all workmen (item 2 in above tabulation) should be charged to the men on the same kind of form.

In the Worthington Works, each of these particular tool kits has been assigned a number, so that when a man starts to work on any given job requiring a kit, the foreman has only to send him to the crib to get the kit he needs, which may be ordered by number. The man signs for the kit and retains it in his possession as long as he works at that particular job.

Outside Erection Tools. Manufacturers of heavy machinery have a number of men in the field at all times erecting their products. The problem of keeping these men properly equipped with tools is very trying and difficult. Their tool requirements are so varied, and the men operate so far from the tool supply, that a complete set of tools must be carried along at all times. On the other hand, the size of the tool box is limited, and the cost of transporting a number of heavy tools over the country is very high. Hence all tools not absolutely required should be left out.

Classes of Tools for Erection Jobs

There are two classes of tools necessary for an erection job:

1. General tools which are used on all jobs, sent out in boxes, and charged to the individual erectors.
2. Tools that are special to each job.

General Erector's Tool Box. This box contains a set of hand tools especially chosen to cover, as far as possible, the various requirements of men in the field. Metal tool boxes of sufficient size to keep these tools in are furnished by the company. These boxes are returned occasionally to the tool crib, and at such times the tools are inspected and any worn or broken tools replaced. A list of such tools is sent to the superintendent of outside erection. Tools broken in the field will be replaced by the tool crib if a broken tool report is sent in. In cases where tools are urgently needed (and the field erector cannot wait for new ones to be sent from the factory), the men are permitted to buy such items from the tool or hardware stores in the vicinity where they are working. In each instance a broken tool report is made out, stating the conditions, and is mailed to the tool crib in the factory. The practice of buying tools at retail stores is discouraged as far as possible because the general purchasing departments can usually secure more favorable discounts.

Special Tools Sent When Required. When special tools, such as large cable slings, air hammers, air drills, etc., are needed on a job, they are sent out from the factory on the first carload of equipment to be installed. These tools should be returned to the factory as soon as possible after completion of the work. In this way it will not be necessary for the individual erectors to ship heavy tools about the country with them, as each shipment from the shop will have the necessary equipment, in addition to the erectors' standard tool box. Any additional tools will be forwarded by the quickest means of transportation upon receipt of order from the erection department.

There is a distinct advantage in handling special tools in this way. The factory knows many weeks in advance when the job will be shipped, and the special tools necessary for the work can be assembled in ample time to go with the shipment.

(To be continued in the August issue.)

Making Exports Balance Production

Systematic Proportioning of Domestic and Foreign Distribution

By DIRK P. De YOUNG

THE late Andrew Carnegie advised us to put all of our eggs into one basket and then watch the basket. But Andrew Carnegie is dead, and that theory along with him, I believe, has passed out of time. Averaging our industrial risks, on the contrary, by putting our eggs into several baskets—and watching them all—is the dictum of present-day management.

Marketing Conditions a Few Years Ago

When Andrew Carnegie was in his prime, industry was not such a large and complicated machine as now. There were no radios then, no airplanes, no automobiles, no many, many things to speed up production and distribution, and sharpen competition, as we know it today. Management and enterprise were largely individual then, while now these are group-like and corporate. Cost accounting, the psychology of selling, cycles, charts, and all this new rigmarole of reducing business to an exact science, was Greek to the Laird of Skibo Castle.

In Andrew Carnegie's day goods and services were not so widely exchangeable for other goods and services as at present. There were more physical barriers in the way. The trading range was consequently more limited. It was the practice to pack eggs in oats in one basket and exchange them for goods at the nearest cross-roads store, the only available market. Now we put up our eggs in fancy cartons and ship them to a thousand marts, from which we get the price of eggs daily by radio or telegraph.

To carry this analogy a step further, to illustrate the changed and changing condition of industry and to explain the general principles of a proper balance between export and domestic distribution, I am going to hark back to the 70's. During that time farmers in Iowa could sell only the hams and bacon of their hogs. Those parts of the animals were shipped to Chicago, New York, and other points for domestic consumption, or exported to Europe, farm-slaughtered and farm-cured. The remainder of the animal had no market, except in the communities where the porkers were raised, because there were no packing facilities, refrigerating cars, or similar means of preparing the product and shipping it to other markets. As a result, the price of those by-products of pork, about half of the hog as utilized today, fluctuated widely in different seasons or in different years. When there was plenty in the community, it was sometimes difficult to give the surplus away, while in off seasons or in lean years, after the cholera had taken its deadly toll of the herd, pork was beyond the purse of the poor of the neighborhood. At the same time, conditions in Illinois or Indiana farm belts were often exactly reversed.

The invention of great packing plants, cold storage, refrigerator cars, fast freight, express shipments, telegraph wires, and a hundred other improvements, which came in rapid succession—and are still coming—revolutionized the system of exchanging the goods and services of one community for the goods and services of another, bringing them ever closer together and constantly reducing the hardships of seasonal or periodical fluctuations in the supply and price of the necessities of life. In other words, the wider range of distributing products in this country has simplified the problem of maintaining an even supply and demand for and from all, reducing waste and community suffering all over the United States. It has done even more. A wide distribution results in quantity production, with lower prices for the product, which further accelerates the exchange of the goods and services of the one for the goods and services of the other. Thus, the wider we scatter our activities, as I see it, the more we average our risks, while the increased production resulting, constantly tending toward greater quantities, cheapens the cost of the product to the consumer, which we all know makes trouble for our competitors.

What I have just said is pretty well understood and appreciated by leaders in business and economic thought in the United States today. They go on that theory generally in handling their products in the domestic market. But when it comes to exporting, it is a very different matter. Some are shipping their goods in many different ways to foreign ports, averaging their risks still further than those who use only the domestic field. But to find any concern which apportions its distribution between home and foreign sales, we have to do like Diogenes—go about with a lantern in broad daylight to find concerns who follow a schedule.

How Much Export Business Is Profitable?

Off-hand, the hard-boiled export expert will tell you that it is impossible to get too much foreign business. But in a recent article, E. G. Mc Dougall, President

of Libby, McNeill and Libby, of Chicago, is credited with saying that a manufacturer can get a top-heavy foreign distribution, too. That concern at one time exported 75 per cent of its products. If, for instance, that percentage was largely in England, with the acute unemployment prevailing there in recent years, it would be a dangerous position for a manufacturer to be in. Exactly the reverse, 25 per cent exported, and 75 distributed in the United States and Canada, would be a much better balance.

Experiences of Several Exporters

On the other hand, James I. Birch, of Burlington, New Jersey, who formerly manufactured rickshaws, exported the whole of their output, nearly all to China—and what else would they do with it? The Baldwin Locomotive Works export 50 per cent of their production, the Waterman Fountain Pen Company one-third of all they produce, while the motion picture industry exports 35 per cent of its films. But the automobile industry of the United States, making a utility for all mankind, and making it better and on a larger scale than any other nation, exports less than 13 per cent of the total production of the country. Thus, with abundant exceptions, 50 per cent of a manufacturer's output sold abroad is a large percentage, while 33 is considered a better proportion by experienced foreign traders with whom I have discussed the subject. Not a few, however, export 25 per cent of their production. The percentage of all production in the United States exported is variously estimated at from 10 to 19 per cent by different economists and statisticians, but, in my opinion, the lower figure is nearer right.

E. M. Herr, president of the Westinghouse Electric and Manufacturing Company, and W. H. Robinson, vice-president of the J. H. Heinz Company, manufacturers of the 57 varieties of food products, both of whom speak for concerns which have a well-balanced export and domestic distribution, recently gave me the benefit of their experiences and ideas along this line. The former company exports approximately 10 per cent of its output, from which distribution it gets various benefits, aside from the direct profits on such business. Some of these are lower production costs on entire production due to export volume, stabilizing of domestic prices in times of surplus capacity by using export markets to some extent for distribution of the surplus.

Indirect Benefits from Exporting

Through exporting, also, a contact with new designs and types is formed which assists in the development of the product for domestic markets. If exporting were not engaged in, domestic development would not have the benefit of foreign progress. Moreover, the export end of a business, these people have learned, keeps the domestic manufacturer in contact with foreign competitors, which may be very valuable later in case the home market is invaded by foreign manufacturers in the future.

One of the greatest benefits of exporting, according to Mr. Herr, is the real low cost of doing this business by spreading existing talent of a concern. That is, apportioning executive department heads and others to export effort without adding essentially to the expense. The cost of this executive and headquarters' talent would be the same if there were no export business and the total, without the foreign sales, would have to be assessed against domestic business only. I also find Mr. Herr concurring in my view, previously expressed, that a well-balanced proportion between the domestic and export distribution of a concern provides a certain degree of inventory control without breaking prices at home. The variations in business of electrical manufacturers between periods of boom and depression are rarely more than 20 per cent from normal, although in exceptional cases it may go double that amount. The experiences of this company, with its world-wide ramifications, confirm further the theory previously advanced in this paper, that the distribution of their activities, both at home and abroad, has averaged their risks, and tended to stabilize their production and sales, because business is always better in some communities than in others.

About 17 per cent of the 57 varieties of the H. J. Heinz Company is exported. That, in my opinion, is a good showing on a food specialty, getting close to what I consider as a good balance for all purposes mentioned. That is indicated, too, from what Mr. Robinson reports regarding the business of that well-known concern as a whole. He informs me that that business is quite uniform and stable, showing a natural, healthy and steady increase from year to year, without violent fluctuations. They look upon their foreign business in much the same way as upon their domestic trade, as an outlet for just so much of their production. Neither are that concern's production and sales sensitive to seasonal variations.

Exports Balance Production

The point, therefore, which I hope I am making clear, is that a well-balanced distribution between the domestic and export efforts of a producer, either an individual or a nation, stabilizes the industry. Just what that particular balance should be nobody knows. It might be very large or small, depending on various factors which I cannot include in a brief discussion of this sort. In one business 25 per cent is good; in the case of the 57 varieties of Heinz, 17 appears to be an admirable proportion; in the Westinghouse enterprise, 10 works pretty well; while in the case of the rickshaw manufacturers, nothing less than 100 per cent of the product exported would be satisfactory. The automobile industry is exporting not more than 13 per cent perhaps of its production. They are aiming at 10 for this year, and all will agree with me, I believe, that they need more than 15 or 20 per cent to relieve the sharpness of competition here at home. The proper balance, whatever it is, should be the point at which the particular business or industry is stabilized, rendering it less sensitive to periodical or seasonal fluctuations.

If I sell in 48 states of the Union, to be more concrete, my distribution should be steadier than if I sell in less than half a dozen. That is the Westinghouse and Heinz experience, which tallies with others. The wider our range, all things being equal, the more we are protected by the law of average that more states out of the 48 will show fair response to sales effort than out of only six. At the same time we concentrate more then in the areas of least sales resistance. And that idea can be expanded indefinitely, for export distribution as well as domestic. Indeed, there are many authorities today who believe that competition in many specialties here at home has become so keen that it would be easier to increase output by export.

Benefits of Wide Distribution

Sometimes, too, political or economic disturbances are confined largely to particular national or geographical boundaries. In such cases the advantage of having our eggs distributed in baskets over the ninety-odd countries of the earth is apparent to all. Often business is poor or spotty in the United States, but good in China, Japan or South America. Taking our exports as a whole, the steady growth in shipments to other continents, aside from Europe, has recently kept our merchandise going abroad in steadily increasing quantities, in the face of Europe's decreased demand for our products. The industry or the manufacturer that has a well-balanced domestic and export distribution when disturbances arise, averages the general

TABLE 1. VARIATIONS FROM NORMAL BUSINESS IN THE DIFFERENT INDUSTRIES, 1912–1918, 1922–1924

Index number 100 = normal

Commodity	High Output	Low Output	Periodical Range	Seasonal Range 1923	Exports
Iron and steel products	122	74	48	22	4.0
Copper *	141	60	81	17	57.8
Bituminous coal	109	67	42	28	3.9
Anthracite coal	108	52	56	74	5.3
Petroleum products	120	96	24	16	22.8
Automobiles	156	73	83	44	4.0
Auto tires	94	73	21	58	4.0
Lumber products	116	91	25	14	....†
Cement	150	76	74	37	....
Tobacco products	119	91	28	24	38.1
Textiles	124	91	33	27	4.0
Newsprint	111	89	22	24	....
Leather—boots and shoes	109	85	24	23	4.0
Chemicals	131	47	84	30	....
Food products, including wheat, other grains and slaughtered animals	115	96	19	16	7.0

* Too much export. Business would be steadier if used here in manufactures and exported as finished goods.
† No data—small amount.

risks better. When periods of depression slacken the domestic demand, the export machinery is rigged for stepping on the gas, where distribution may temporarily be doubled, thus relieving the domestic market of what usually develops at such times into a pandemonium of price cutting and contract cancellations.

The exporting manufacturer, as compared to the non-exporting manufacturer, will be getting orders from many countries, while the latter has but the one source to rely on when domestic trade sags. Needless to say, without appearing to boost the export business, which has already suffered too much from boosting literature, that, however, means much to a manufacturer, much to the community in which the plant is located, and much to the country as a whole. The composite results of the 17,000 American concerns now co-operating to increase the export of our products, plus many more constantly being recruited to the ranks, are already stabilizing domestic enterprise.

Perhaps the best way to approach the solution of a proper balance between domestic and export production, in any particular industry, is the range of variations from normal, during periods of boom and depression. Seasonal variations which are considerable in many industries can also be narrowed by increasing the export balance to countries where the seasons of the year are different, such as South America, for instance, where the spring, summer, autumn and winter are the reverse of the United States. If the range in variation in domestic demand is only 10 per cent, then the regular export of a comparatively small proportion of the output would help a great deal in steadying the business of the manufacturer. But if the variation, both seasonal and periodical, in the domestic market is much wider, which it is in many industries, it would then require a much larger proportion of exports to serve as a balancing factor. The fluctuations, as you are undoubtedly aware, are sometimes 50 or 60 per cent up or down—generally down—from normal business. In such lines, I believe the export balance should be proportionately larger.

TABLE 2. VARIATIONS FROM NORMAL BUSINESS IN DIFFERENT INDUSTRIES, 1920–1923 INCLUSIVE *

Index number 100 = average for 1919

Commodity	High Output	Low Output	Periodical Range	Seasonal Range 1923
Foodstuffs	110	91	19	25
Textiles	112	93	19	35
Iron and steel	128	56	72	41
Lumber	136	88	48	38
Leather and shoes †	97	79	18	38
Paper	110	89	21	25
Chemicals	139	104	35	33
Cement, clay, glass	124	81	43	38
Metals, non-ferrous	153	82	71	42
Tobacco	107	95	12	37
Miscellaneous	114	65	49	46

* In general most of the factories of the country are only working at from 60 to 85 per cent of their capacity under these production figures.
† In nine months of the year the shoe factories of the United States can make all the shoes they can sell in twelve months in the domestic market.

I have tried from various quarters to obtain a complete range of variations from normal business in the different industries, but no such statistical work has been completed, although from valuable data supplied by the Standard Daily Trade Service, and E. Dana Durand, Chief of the Division of Statistical Research, Department of Commerce, I have been able to prepare a table of my own in the key industries, which may serve as a guide, quite as relative as the Einstein theory. These figures are based on a relative output 100 per cent normal, with the secular trend eliminated, covering the years from 1912 to 1924 inclusive. Although other tables which I have consulted do not do that, I have omitted the years 1919, 1920 and 1921, because I consider them such abnormal years as would

only occur once or twice in a century. They were the years in which we experienced abnormal overproduction due to the World War and abnormal reactions in which the aforesaid abnormal output had to be disposed of. This list, shown in Table 1, relative and imperfect as it may be, will, I believe, answer our purposes for comparison.

Results of Fluctuations

The ranges are, of course, the average ranges of a whole year. The actual annual dips and bulges are even more pronounced. Another table, covering only the years 1920 to 1923 inclusive, with the index numbers on a basis of 1919 production as 100, which I think is too short a period and too abnormal in its character for a study of this sort, is given in Table 2.

The indexes of factory employment in these great key industries go up and down, above and below normal, in the same proportion. All enterprises feel these changes, all classes of people are affected by them. Consequently, anything which tends to stabilize the exchange of goods and services for other goods and services—which is the sum total of all business—is especially desired. To illustrate one step further the extent of these industrial booms and depressions, the government Bureau of Census' index of manufacturing production representing weighted changes in the combined quantity of output of 65 different commodities shows that, taking 1919 as a base equal to 100, the combined production in 1921 stood at 80, or 20 per cent below 1919, while the combined production in 1923 stood at 118, or 18 per cent above the base, and nearly 50 per cent above 1921. The range from the lowest month of 1921 to the highest month of 1923 was much greater, from 68 to 133. Those were very abnormal years, of course, years which we shall not soon forget, especially 1921, but those firms which had a fair portion of their eggs in different baskets going to market all over the world, such as the 57 varieties of the H. J. Heinz Company sold in more than 57 foreign countries, felt the shock of that hectic period least of all.

The volume of employment in American manufacturing industries in 1923, taken as a whole, was 29.5 per cent greater than in 1921, while the minimum month of the latter year showed an index of 95.8 and the maximum month an index of 131.3. Broadly speaking, the data for 1924, which is not yet complete, does not differ much from 1923, although in some cases the volume of business and employment has been somewhat lower. Concurrent with this improvement in employment and industrial output during the last two years, which seems to be more than coincident, our export business as a whole, especially the export of manufactured goods, has expanded materially.

From a recent study of the foreign trade trend of the United States, these points seem to stand out clearly: First, after allowing for normal growth, and eliminating the abnormal bulge of the war period, our exports in quantities have steadily increased for a long period of years. Secondly, the character of our exports are gradually changing from raw materials to the finished product of our factories, while our imports are shifting to raw materials and away from manufactures, which indicates that we shall have to depend on the export of our manufactures to pay for the raw materials we import, and for other international settlements. Third, the total foreign trade of the United States is growing faster than that of nearly any other country of the world. Even though the total foreign trade of the world in 1924 was $9,000,000,000 less than in 1914—basis 1914 dollar—our own exports last year were about 22 per cent greater in quantity than 10 years before.

We do not, of course, export as much per capita as some of the other countries of the world. We don't have to. We still find the home field too good for exchanging our goods and services between ourselves. In the United Kingdom, the exports per capita were $74 in 1923, as against $37 here. The figure for Germany is lower than for the United States, but this is because of the general disturbance of business in that country. In pre-war years the German figures were higher than ours. In most of the northwestern European countries, in spite of less wealth, the per capita of exports is also probably higher than ours. That is the case with many of the European countries—they have to export more in order to pay for what they have to import. And while these are compelled to export large quantities of manufactured goods, to pay for large imports of food and raw materials, such countries as Argentina, Australia, Canada and Cuba also export more raw materials per capita than we do to pay for imported manufactures, which the latter do not produce at home. On the basis of figures covering 1924, our exports for the entire year have amounted to $4,588,000,000, an increase of about $500,000,000 for 1923, approximately 15 per cent of the foreign trade of the world. During the 1924 period our imports were $3,610,000,000, or a decrease of nearly $200,000,000 over 1923, our favorable merchandise balance amounting to more than a billion last year, increasing our total credits abroad as a nation to somewhere near $18,000,000,000.

Objects Gained by Well Balanced Exports

Averaging risks is the object of a well-balanced proportion in the export and domestic distribution of a plant or of a nation. There can never be too many goods nor too many services. But the proportion and distribution of goods and services often get out of balance. And while some such theory as Einstein's may have to be utilized in setting up the standards for balancing factors, as between export and domestic sales, the idea of definite aims of some kind along this line, it seems to me, is at least sound in principle.

Foreign markets may be developed and utilized only to the extent necessary to even out the fluctuations in domestic consumption, or they may be developed more intensely while still retaining their value as a production balance wheel. Whichever plan is adopted, manufacturers usually will find that even a relatively small foreign market means much to their production schedules and costs.

Better Shipping Containers

Standard Boxes, Crates, Bales, Barrels, Bundles, Drums, Tubs, Sacks, Bags, Rolls and Baskets

By FLOYD T. SMITH

Industrial Department, General Electric Company

THE principal types of containers[1] used for conveying or transportation may be classed as follows:

1. Rigid, completely enclosed containers for solids. Examples: Box, barrel, tub, case, closed crate, carton, tube.
2. Rigid, partially enclosed containers for solids. Examples: Tray, tote box, open crate, shop barrel, skid or live platform, bucket skip.
3. Non-rigid containers for solid or bulk materials. Examples: Bale, bundle, sack, bag, roll, net, carton.
4. Containers for liquids. Examples: Barrel, drum, cask, hogshead, can, carboy, pan, bucket.

Merchandise may be classed in various ways—heavy and light, perishable, or otherwise. For convenience, from the manufacturer's point of view, it may be classified by form under six divisions, easily remembered by six B's: Bags, barrels, boxes, bundles, bales and bulk. These six general forms are known by different names in various industries; for instance, a "bag" of sugar, but a "sack" of wheat. Boxes include cases, crates, cartons, chests, and other non-flexible packages of a general cubical shape. Barrels cover kegs of nails, tubs of butter, rolls of fence wire and other non-flexible cylindrical packages. Bales are pressed and tied packages of materials of a general cubical shape but without any hard, flat surface. The term "bundle" covers a great variety of names and forms, such as "laps" of pulp, "quarters" of beef, "spools" or "reels" of barbed wire, "hampers," "baskets," etc. Bulk includes such loose materials as grain, coal, sand, etc., as well as compact materials such as pig iron, sheets of steel, blocks of ice, logs, etc., which are handled as independent pieces.

Container Characteristics

Each of these classes of merchandise has its own peculiarities of shape, weight, size and individual characteristics, all of which have their effects on the method of handling, method of storage and the design of handling equipment. As an example of this, the most common form of package, the bag, may be considered. Many persons look on bags only as bags, but there are bags of various shapes, sizes, weights, flexibility and material; there are bags weighing from a few pounds up to 500 or 600 lb.; there are bags of paper, linen, cotton and jute; there is the round, compact, non-yielding sack of wheat and the flat, oblong, loosely packed bag of feed; there is the small bag of cement and the large bag of China peas, in which the material flows about freely like water, and there is the heavy sticky bag of Cuban sugar, one of the most difficult to handle. And there are still other kinds of bags, such as the bag of wool, 6 ft. long; the bag of flour, so liable to damage, and the bag of linseed cake, as solid as a piece of granite. Each of these bags calls for special treatment in the design of handling equipment.

Similarly, there are differences in equipment for handling bales of hay, bales of cotton, sisal, scrap paper, scrap tin, etc., and for barrels with large or small bilge, or open heads, small kegs and metal cylinders. Especially there are differences for the great variety of bundles and bulk. In the paper industry there are over 250 different varieties of paper (not counting grade classifications or trade-names), and these are put up in a large variety of package forms, some of which require decidedly specialized designs of carriers and methods of handling. As an example, wall-paper is put up in rolls and will crack easily on the edge even with a slight blow—a crack only an eighth of an inch deep necessitates stripping off and wasting about 8 yd. of paper. Thus, in handling wall-paper, the prevention of damage to the roll is generally of greater importance than speed.

Standard Containers

A list of the standard containers is shown in the following tabulation:

METAL CONTAINERS

Pans	Kegs, Barrels (liquid, oil, varnish)
Pails	Drums
Tubs	Vats
Tins	Kettles
Tanks	Pots
Cans	Measures
Cups	

[1] For preceding articles see MANAGEMENT AND ADMINISTRATION for April 1925, p. 349; May 1925, p. 421; June 1925, p. 549.

WOODEN CONTAINERS

Boxes	Pails	½ Barrels
Buckets	Tierces	¼ Barrels
Cases	Trunks	Drums
Carcases	Tubs	Tanks
Casks	Vats	Keelers
Chests	Hogsheads	Firkins
Baskets	Barrels (apple,	Measures
Hampers	potato, sugar,	Dishes
Crates	flour)	Piggins
Hods	Barrels (liquid, oil,	Puncheons
Kegs	molasses)	

FIBER AND FIBERBOARD CONTAINERS

Cups	Boxes	Rolls
Dishes	Pails	Drums
Cartons	Bags	

BURLAP, BAGGING AND SACKING CONTAINERS

Pouches	Bags
Sacks	Bales

GLASS AND EARTHENWARE CONTAINERS

Carboys	Jugs	Tubes
Cups	Jars	Bottles
Dishes	Mugs	Pots

The principal types of standard containers may be defined briefly as follows:

Box. A box is a rectangular closed container and is usually made of wood, fiberboard or metal. It is the most common type of package in use. Boxes are also sometimes called "cases."

Crate. A crate is a container, usually although not necessarily rectangular in shape, consisting of a frame to which are fastened slats or braces. It may also be entirely closed or sheathed over so that it looks like

FIG. 1 BAKER, RAUCH AND LANG ELEVATING PLATFORM TRUCK CARRYING LOAD OF AXLES ON SKID PLATFORM

a box, but, if so, it differs from a box in that it has an inside reinforcement of framework or bracing. Crates are generally made of wood, although occasionally of metal. A completely closed or sheathed crate is frequently called a "case."

Bale. A bale is a package that is generally covered with burlap or some other textile material, matting or reinforced paper, and securely bound with steel strapping, wire ties, rope or strong cord. Bales are often compressed, either by machines or by very com-

FIG. 2 COWAN ELEVATING PLATFORM TRUCK READY TO ELEVATE SKID LOADED WITH TWENTY WOODEN BOXES

pact packing. A bale differs from a wrapped bundle or package in that it is more firmly packed or more securely wrapped and bound.

Barrel. A barrel is a closed cylindrical container with round flat parallel heads of equal diameter and with sides having a bulge or "bilge." Barrels are usually made of wood or metal. The barrel, in some forms, is one of the strongest and probably the most sanitary—and therefore one of the most desirable—of all containers. It has the greatest range of use, with the exception of the box, and is one of the cheapest and most convenient forms of all packages. The barrel is easy to handle, as it can be rolled, whereas the rectangular package must be lifted. It also serves as protection from damage and weather.

On the other hand, the barrel does not stack well; it usually requires two men to handle it; as a rule it rolls with tempting ease and, in consequence, is subject to knocks never offered the lighter and more convenient container. In storage it is seldom securely placed and, when required again, invites the same rough treatment which it received during transportation.

Bundle. The word "bundle" is used in two senses: (1) A package generally paper-wrapped and as a rule bound with cord, tape or string; and (2) a package consisting of a number of articles bundled together and bound firmly at several places with wire, rope, cord or strapping. Shovels, handles, box shooks and similar articles are often shipped bundled in this manner.

Drum. A drum is a closed cylindrical container with round, flat paralled heads of equal diameter and with straight sides without bilge. Drums are usually made of wood, metal or fiber. A can is a form of a drum but is usually smaller. Cans in the larger sizes have open tops and, often, reinforced sides for strength. The smaller cans, such as are used in the canning in-

dustry, have both tops and bottoms closed or sealed. The milk can is a modification, being irregularly shaped.

Tub. A tub is a cylindrical container with a round, flat bottom, usually tapering sides and a round top. The diameter of the top is usually larger than the diameter of the bottom and, for shipping purposes, the top is fitted with a cover. Tubs are generally furnished with handles on the sides. They are made of wood, fiber or metal. A pail or bucket is very similar to a tub but is generally smaller and has a different type of handle.

Sack. A sack as a rule is a closed container made of burlap, cotton or other textile material, or sometimes of paper. Sacks are generally made of a rectangular piece of material folded over and with the edges stitched, sewed or pasted together, leaving the top open for filling. After filling, the top is sewed or pasted together, or the loose end gathered together and tied.

Bag. A bag is a closed container very similar to a sack and is generally made of textile material or paper. Bags, however, often have a square or round bottom which gives them a greater carrying capacity than sacks.

Roll. A roll is a cylindrical package usually covered with burlap, other textile material or paper and either bound with cord, rope, wire or strapping, or sewed up, or pasted. Rugs, paper and roofing are commodities which are often shipped in rolls.

Basket. The basket is a container usually cylindrical in shape with tapering sides and round top. It is constructed of splint or wood. Some are furnished with handles at the sides and, for shipping purposes, the top is fitted with a cover. Baskets may be rectangular in shape and are provided with a handle at the center. The hamper is a form of basket and is often furnished, especially in the larger sizes, with

FIG. 3 LOADED LIVE PLATFORM AND TRUCK

small wheels on the bottom. The hamper is made of splint or solid fiberboard or of bagging on a metal or wooden frame.

The design and construction of the container, the method of detaching or fastening it and the manner in which it is moved, all save time and extra handling. This is particularly true of those used (1) as containers with special features for material, or (2) as containers, holders or carriers for several smaller containers. The following types are available:

Tote Boxes. Tote boxes are rectangular metal or wooden containers in many sizes and shapes. They are used in industrial plants for small parts and material in course of manufacture that can be readily moved in this container from one operation to another.

Barrels. Specially designed, metal, barrel-shaped containers, or barrels either with a flange at the top or a carefully designed bilge, are used in machine shops and industries for holding filings, chippings, turnings, small castings or parts and scrap material. This form of construction permits easy handling by truck or on skids, and moving from one machine to another, or from one part of a building to another.

Live Platforms

The live platform is furnished with wheels. This gives a more flexible means of moving material, as the platform, when loaded, may be pushed or pulled short distances by hand. The wheels are of such diameter that the platform will be of the proper height for the hand or electric elevating platform truck. If material is to be moved some distance to another department, it can be picked up, with the platform, and carried to its destination without rehandling.

Skid Platforms. These require an elevating truck to move when loaded. They can be used with either the hand lift truck, the elevating platform or the tier lift power truck. Their field is limited either to loads to be used immediately after being delivered at destination, or to dead storage, where the entire load is held for a considerable period.

The skid idea is now developing rapidly in a direct application to the speeding up of production. Platforms are cheap; labor cost is ever growing. Skids in the many convenient forms of specially contrived boxes, containers, bin sections, crates, racks or tables, machine high or otherwise, are lessening the number of time-consuming motions in handling material.

The proper heights of these platforms from the floor permits them to be used interchangeably with either the power or the hand truck. The skid platform, a container for handling, has been adopted quite generally in many plants. The basic part is the simple platform, or a modification of this, and a simple frame with four legs of proper height. From this are developed many forms, each of which best suits a particular method of material moving.

If the platforms or legs of any of these many forms are furnished with wheels, it then becomes a live platform in the sense that it can be moved, pushed or pulled, either empty or loaded, without being lifted by hand or power truck.

The cinch board is ingeniously designed and renders valuable service in material handling. It is recommended particularly for loading and unloading package freight or less-than-carload freight from cars to load-carrying truck or trailer, and from load-carrying truck or trailer to ship's hold.

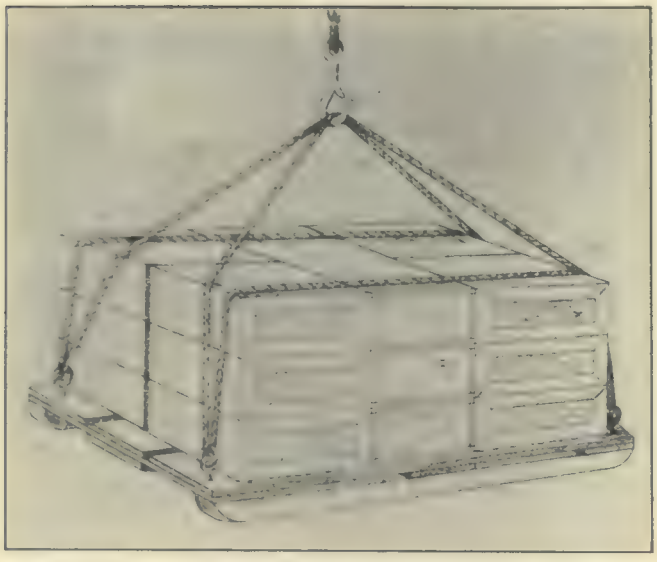

FIG. 4 A CINCH BOARD, USED FOR LOADING AND UNLOADING PACKAGE FREIGHT

The dimensions are approximately 5½ ft. long by 2½ ft. wide. It has a capacity of 50 cu. ft. and from 1 to 1½ tons can be loaded on it. The cinch board projects beyond the load at each end, so that the material itself is relieved from shocks and breakage. The construction consists of three heavy wooden pieces, lengthwise jointed at each end and in the middle, with three pieces of the same size running crosswise. Under this, at the center, is a third piece running lengthwise. These parts are securely fastened. The frame, thus constructed, is fitted with heavy oak skids on the under side. At each corner on the upper side is an eye bolt with a ring. Through the two rings at each side is a rope about 20 ft. long. Both parts of the rope, at each side, are laid to one side while the cinch board is being loaded. After loading, the rope is brought up over the box or material, one part of the rope from each side is put on the hook and, as the cinch board with its load is lifted, the rope at both sides tightens over the load, holding it securely in place. The rope slips enough through the hook to give the cinch board with its load a horizontal position while being hoisted or lowered.

Demountable Bodies

The use of a demountable body is a convenient method of moving large quantities of material at one time with one movement. This type of container is used as interchangeable equipment between motor trucks of from 3 to 5 tons capacity and trailers of equal capacity. The capacity of these bodies is limited to a truck-load.

Demountable bodies are manufactured in two principal types, open and completely enclosed. The open type has staked sides and ends. The enclosed type has side or end doors. Either type forms a complete body for a large motor truck or trailer. These bodies are provided with hooks or attachments by which they can be lifted from the truck chassis with an overhead crane or other appliance. The lift and travel of the crane is controlled by one operator standing on the floor near the truck. The body is carried to the proper position on the floor of the terminal or warehouse. It is placed near the railroad cars, or near a stockroom or storeroom containing similar classes of commodities. The door at the side or end can easily be thrown open, or the stakes removed at one end from the open type. For loading or unloading, the material is moved the short distance by hand truck.

These can be used as an interchangeable equipment between motor truck or trailer freight car, and barge or ship. It is interesting to note that one of the leading railroads is using this type of container.

These units are built of sheet metal of rugged construction in many sizes. The size of the unit would be regulated by the demand but probably the two sizes most used are the 10-ton size and the 2½-ton size, the latter to hold 70 bu. or 3 cu. yd.

They can be mounted either on a standard flat car or on a flat car with the upper part of the platform built to hold them. One car can be loaded with 5 of the larger sizes or 20 of the smaller size.

The units are of two kinds, one to unload from the side and the other through a drop bottom. The one loading and unloading from the side has a folding door that slides down. It is intended for less-than-carload freight and cannot be unlocked without removing it from the underframe. This eliminates pilfering. The one unloading from the bottom is intended for all kinds of bulk freight.

The larger unit is arranged to be lifted by a crane

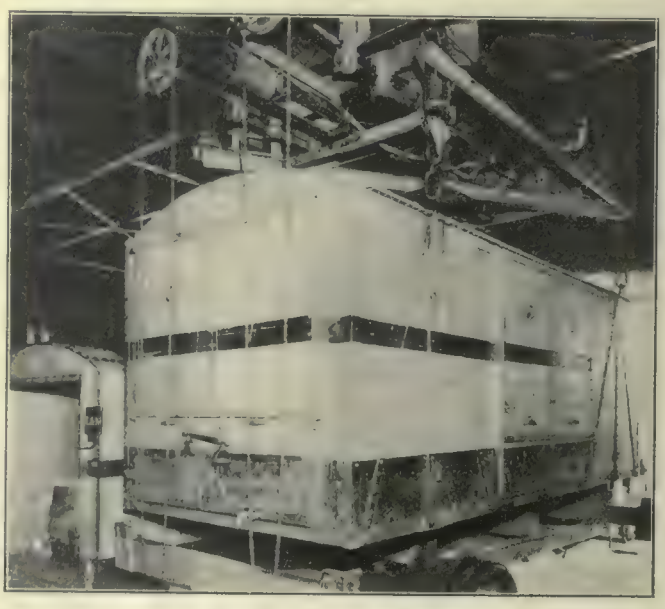

FIG. 5 OVERHEAD CRANE, WITH SPRAGUE HOISTS PLACING A DEMOUNTABLE BODY ON A TRUCK CHASSIS

from the underframe and carried into the warehouse. The smaller unit can be lifted from the underframe and placed on a trailer truck or on the chassis of a large gasoline engine truck. The adoption of a flexible unit by means of a multiple makes it possible to load more nearly to capacity; makes unloading easier and faster; releases equipment on arrival, and furnishes a more direct delivery from factory to consumer.

Practical Balance Sheet Analysis

By G. M. PELTON

Comptroller's Office, Swift and Company

THE primary purpose of analyzing balance sheets, together with the supporting facts and figures covering buying, manufacturing and selling activities, is to develop constructive information which will be of direct assistance to executives responsible for the manufacturing, merchandising and general financial functions of a business. In this connection it should be borne in mind that the average executive has an abhorrence for technical figures and statistics. He is not interested in an involved so-called "scientific" compilation. Neither does he want an elaborate report that fails to fit in with his local requirements. He has not the time to read it or to trail through a wilderness of figures to get a single fact. But he is keenly anxious to get concise and practical information, served in simple short doses, which will help him to manage his business more satisfactorily and secure better results.

In recent months much has been written on balance sheet analysis. Broadly speaking, the methods proposed divide into two groups: (1) The "index" method outlined by Stephen Gilman[1]; and (2) the "ratio" method described by J. H. Bliss in his book on "Financial and Operating Ratios in Management."

It is not my intention to make a detailed comparison of these methods for that has been done by Spencer B. Stevenson.[2] I do intend, however, to point out the leading advantages and disadvantages of each, and to show how this work may be done to be of practical value to the business executive.

The fundamental and possibly fatal weakness of the index method is that it requires the executive to visualize his business changes through a maze of intricately scientific statistics devoid of the actual dollars and cents values that apply. For example, suppose by the index method you tell an executive that his fixed assets totaled $17,922 in 1921 and, using that figure as the base or 100 per cent, say that the 1922 percentage was 144 per cent, the 1923, 201.7 per cent and the 1924, 208 per cent. Would these percentages in themselves mean much to him or to you? Wouldn't he want to know the amount of money tied up in fixed properties, and the ratio of these properties to sales and volume of business handled?

The point is that strictly balance sheet statistics or indexes are more or less relative, artificial and incomplete, do not tell the full story, and are liable to mislead. It is infinitely better to furnish the executive with a comparison of analytical balance sheets, sales and turnover figures, and details of his operating and merchandising activities. He is then in a position to see the actual facts and figures that apply to his operations, and to know whether the money he has tied up in accounts, inventories, fixed properties and total assets is working more or less efficiently than it previously had worked. Information of this kind is vitally important because it shows the weak spots and

TABLE 1. COMPARISON OF ANALYTICAL BALANCE SHEETS

Ames Manufacturing Company

	1921	% Total Assets	1922	% Total Assets	1923	% Total Assets	1924	% Total Assets	Increase or *Decrease** 1924 over 1921
Assets									
Cash	$ 4,652	8.5	$13,371	19.6	$ 7,190	9.0	$10,512	13.4	$ 5,860
Accounts Receivable	14,468	26.4	8,217	12.1	5,629	7.1	5,857	7.5	*8,611*
Inventories	17,556	32.1	20,607	30.3	28,077	35.3	22,210	28.4	4,654
Total Current Assets	$36,676	67.0	$42,195	62.0	$40,896	51.4	$38,579	49.3	$ 1,903
Prepaid Expenses	76	0.1	213	0.3	2,545	3.2	2,459	3.1	2,383
Fixed Assets	17,922	32.9	25,707	37.7	36,163	45.4	37,290	47.6	19,368
Total Assets	$54,674	100.0	$68,115	100.0	$79,604	100.0	$78,328	100.0	$23,654
Liabilities									
Notes Payable Trade	$ 1,000	1.8	$		$ 3,000	3.8	$ 1,000	1.3	$
Notes Payable Bank	4,000	7.3	4,000	5.9	3,000	3.8	2,000	2.5	*2,000*
Accounts Payable	7,000	12.8	4,000	5.9	8,000	10.0	5,000	6.4	*2,000*
Dividends Payable	2,000	3.6			2,000	2.5	2,000	2.5	
Accrued Liabilities	128	0.3	690	1.1	337	0.5	248	0.3	120
Total Current Liabilities	$14,128	25.8	$ 8,690	12.9	$16,337	20.6	$10,248	13.0	$ *3,880*
Capital Stock Outstanding	50,000	91.5	50,000	73.3	50,000	62.8	50,000	63.9	
Surplus or Deficit	*9,454*	17.3	9,425	13.8	13,267	16.6	18,080	23.1	27,534
Total Net Worth	$40,546	74.2	$59,425	87.1	$63,267	79.4	$68,080	87.0	$27,534
Total Liabilities and Net Worth	$54,674	100.0	$68,115	100.0	$79,604	100.0	$78,328	100.0	$23,654
Net Working Capital	$22,548		$33,505		$24,559		$28,331		$ 5,783
Ratio	2.6		4.8		2.5		3.7		
Dollars Sales	$52,088		$66,383		$90,652		$96,691		
Turnovers Accounts Receivable	3.60		8.07		16.10		16.51		
Turnovers Inventories	2.96		3.22		3.23		4.34		
Turnovers Fixed Assets	2.91		2.58		2.51		2.59		
Turnovers Total Assets	0.95		0.97		1.14		1.23		

* Italics indicate decrease.

[1] MANAGEMENT AND ADMINISTRATION, August 1924, p. 147.

[2] MANAGEMENT AND ADMINISTRATION, March 1925, p. 223.

places where further improvements should be made.

Table 1 is a comparison, based on figures taken from Mr. Gilman's article previously mentioned, together with sales and turnover figures. It shows the balance sheets in both money values and percentages, and sales and turnover figures. For instance, the inventories were $17,556, or 32.1 per cent of total assets in 1921, during which year the sales were $52,088, producing a ratio of sales to inventories of 2.96, which means the number of times each dollar in inventories earned a profit that year, as compared with these figures:

	Value	*Per Cent to Total Assets*	*Sales*	*Turnover of Inventories*
1922	$20,607	30.3	$66,383	3.22
1923	28,077	35.3	90,652	3.23
1924	22,210	28.4	96,691	4.34

This method is much more complete, satisfactory and natural than the index method, by which the same information would be presented somewhat as follows:

The inventory in 1921 was $17,566
Or ..... 100 %
And in 1922, as compared with the previous year, was... 117.3%
In 1923 it was 159.9%
And in 1924 ..... 126.5%

These index figures do not tell the full story, for the executive wants to know the amount of money tied up in inventories. To illustrate: Under the index method the inventory in 1923 was 159.9 per cent of the 1921 figure; also, from Table 1, the 1923 inventory was 35.3 per cent of total assets, or the highest percentage for the four-year period. At first glance this might lead you to believe that there was an unusually large and unjustified stock of goods and materials on hand in 1923. As a matter of fact, just the opposite was true. That is, the ratio of sales to inventories increased. Therefore, each dollar tied up in inventories in 1923 actually worked more times in 1923 than it previously had worked.

These kinds of ratios and relationships, measures and turnovers, together with the actual figures, present the facts in a simple and dependable way so that they may be readily understood and used by the average executive. Of course, various kinds of ratios and measures may be used, such as earnings, costs and expenses, turnovers and financial relationships, etc. The most important ratio of all is that of final net profits earned on net worth, a basic measure which is not provided for by Mr. Gilman in his plan.

In Table 2 appears a suggested form which may be used in making comparative analyses on a yearly, semi-annual, quarterly, monthly, or other basis, depending on local requirements. As many periods can be put in comparison as desired. Of course, in the average concern, various other kinds of financial analyses need to be made from time to time, many of which approach the problem from a different angle.

In general, the leading ratios and measures used in analyses for management purposes summarize as in the following classification. Naturally, all of these ratios or measures are broad and assume that underlying detailed ratios and measures are made supporting each of them.

Measures of Earnings:

- Relation of surplus net profits to net worth.
- Relation of surplus net profits to volume of business, from both weight and value standpoints.
- Earnings on common stockholders' investments.
- Relation of operating profits to total capital used.
- Relation of operating profits to volume of business, from both weight and value standpoints.
- Relation of gross earnings to volume of business, weight and value.

Measures of Costs and Expenses:

- Relation of costs and expenses to volume of business, weight and value.
- Relation of property expenses to investment and sales.
- Cost of borrowed capital; and total financial expenses.
- Cost of total capital employed.
- Unit expenses of all kinds.

Turnovers and Financial Relationships:

- Turnover of total capital employed.
- Turnover of inventories.
- Turnover of accounts receivable.
- Relationship of fixed property investment to volume of business, weight and value.
- Working capital ratio.
- Sources from which capital is secured.
- Manner in which capital is invested.
- Proportion of earnings left in the business.

TABLE 2. FORM FOR COMPARATIVE ANALYSIS

PARTICULARS	YEAR OR PERIOD	% TOTAL ASSETS
Cash Account	$	
Accounts Receivable		
Inventories		
Other Current Assets		
Total Current Assets	$	
Investments	$	
Fixed Property		
New Construction		
Intangible Fixed Property		
Deferred Charges		
Total Capital Employed	$	
Accounts Payable	$	
Notes Payable		
Other Current Liabilities		
Total Current Liabilities	$	
Long-Term Liabilities	$	
Deferred Liabilities		
Reserves		
Preferred Stock		
Common Stock		
Other Stock		
Surplus		
Net Worth	$	
Total Liabilities and Capital	$	
Net Working Capital	$	
Working Capital Ratio		
Volume of Business (Units Shipped)		
Units Shipped per $1 of Plant Investment		
Sales—Amount:		
Dollar Sales per $1 of All Capital	$	
Dollar Sales per $1 of Plant Investment	$	
Dollar Sales per $1 of Inventory	$	
Dollar Sales per $1 of Accounts Receivable	$	
Gross Earnings per Unit	$	
Expenses per Unit	$	
Operating Profits per Unit	$	
Miscellaneous Loss and Gain	$	
Interest Cost	$	
Per Cent on Borrowed Money		
Surplus Net Profits	$	
Per Cent on Net Worth		
Dividends—Preferred	$	
Dividends—Common	$	
Dividends—Other (Bonus)	$	
Surplus Adjustments	$	
Net Change in Surplus	$	
Book Value of Common Stock	$	
Per Cent Earned on Common Stock		

Concrete in Industrial Buildings

Where, How and Why It May Be Used Profitably

By W. E. HART

Manager, Structural Bureau, Portland Cement Association

EVERY owner, president, or general manager of a manufacturing plant is sooner or later faced with the necessity of building some sort of structure. The first question that he must settle is what material to use for construction purposes.

Reinforced concrete has been growing rapidly in use as a structural material, due in part to the recent scientific study of its make-up and proper preparation. The hazards of the old pioneer "rule of thumb" days, when contractors placed concrete by methods which approximated guesswork, have been overcome. Another factor in the increased use of concrete has been the improvement in methods of concreting in cold weather. This has made it practicable to carry on building operations in concrete all the year round, instead of closing down for a three months' period during the winter, as was formerly customary in nearly all lines of building construction.

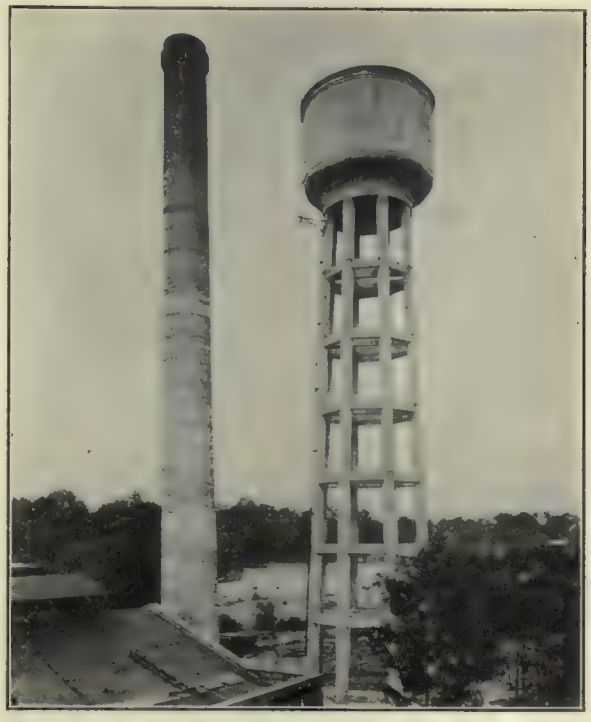

FIG. 1 CONCRETE CHIMNEY AND WATER TANK

Concrete, both plain and reinforced, is used in a great many ways in all kinds of structures. Already, manufacturing plants constructed almost entirely of concrete are seen on every side. Other structures of concrete commonly seen about industrial plants are chimneys, tanks, storage bins, coal pockets and material elevators.

Chimneys of reinforced concrete are being built in increasing numbers because they are economical and strong and have proved their ability to resist bending stresses caused by high winds. (See Fig. 1.)

Concrete water tanks and stand pipes have been used by many industrial plants for fire protection and to supply various plant needs. If properly built they are durable and require no repairs.

Concrete tanks are also used for storing mineral oils, and are often built underground, thus leaving valuable ground space above for other uses. They are extensively used for storing chemical solutions, tanning preparations, brine, molasses, vegetable oils and a variety of other liquids used in manufacturing processes, and for this purpose are economical and durable, being unaffected by the action of rust and rot. For storing strong chemicals or similar liquids, however, a concrete tank must be lined with some other material to resist corrosion. (See Fig. 2.)

Concrete storage bins, both inside and outside, facilitate cleanliness and eliminate losses. They are fireproof and moisture-proof and repel vermin. In the form of grain elevators and coal pockets they are seen everywhere. One of the largest grain elevators in the world, located at Buffalo, has a capacity of 5,000,000 bu. (See Fig. 3.)

Many structures are built with concrete block, building tile, and roofing tile. The common concrete block is 8 x 8 x 16 in., but they are made in a large variety of sizes and shapes. The standard concrete building tile is 5 x 8 x 12 in. Both the block and building tile are used extensively for inside and outside walls. They also lend themselves to the construction of small buildings, pump houses, and storage bins. An attractive finish on these buildings may be obtained by the use of stucco, which is readily applied to walls of block and tile.

Concrete roofing tiles, averaging a half inch in thickness, are extensively used, and make an excellent fire-resistive covering. Cement asbestos shingles are also favored.

Fences and retaining walls of concrete are cheap to build and cost little to maintain.

The question of the profitable use of concrete should include a brief mention of concrete foundations. They are used in many forms, including concrete piles, footing courses, walls, and spread and cantilever foundations. Machinery and power equipment foundations are now commonly made of concrete. When a con-

FIG. 2 CRESCENT REFINERY CO. MINERAL OIL TANKS

crete foundation is carried down to bed-rock, it is there to stay.

The development of concrete for industrial uses is being materially aided by the scientific research of Professor Abrams and other investigators, which has increased the confidence of architects and engineers in the strength and durability of this "stone you can mould."

Professor Abrams began his present work nine years ago, after having already spent twelve years studying concrete. He is engaged jointly by Lewis Institute and the Portland Cement Association, an organization formed to improve and extend the uses of concrete. His instructions were: "Find out all you can about concrete," and he was given liberal resources, a laboratory and a corps of assistants to carry out his work.

Perhaps Abrams' most important contribution was his discovery that the best concrete is made with only enough water to give a workable mix. This principle has been universally accepted by engineers, and is now being extensively applied in practice. Consequently, stronger concrete is being obtained at less cost. He has also worked out methods for mixing concrete to get certain desired strengths, which has also led to greater economy. He has developed several practical methods for testing sand, water and stone, which engineers in the field are now using successfully.

Another important part of his work was his study of the treatment of concrete after placing, which was more complete than the earlier investigations of others. He definitely established the value of keeping it moist for at least ten days, proving that if so treated it attained much greater strength for resisting abrasion and wear. Applied to concrete roads, this discovery has produced better wearing surfaces. It has also improved the construction of factory floors, where "dusting" was overcome by this improved method of construction.

For most kinds of buildings, mill construction (heavy timber framework and wood floors), brick, reinforced concrete and structural steel are all serviceable. They vary in cost, usually increasing in the order named.

First Cost. The factor of first cost, although it should not predominate, is necessarily of importance. A reinforced concrete building ordinarily has been assumed to cost slightly more than one of mill construction, although concrete warehouses and similar buildings designed for heavy floor loads have long been built for less than any other type would have cost. Since the war, however, changes in the material and labor markets have cut down the slight difference between cost of mill and concrete construction. The price of lumber and wages of carpenters, the main items in mill construction, have gone up, whereas the prices of reinforcing steel and Portland cement, ingredients of concrete, have receded. The wages of the common laborers used largely in concrete work have

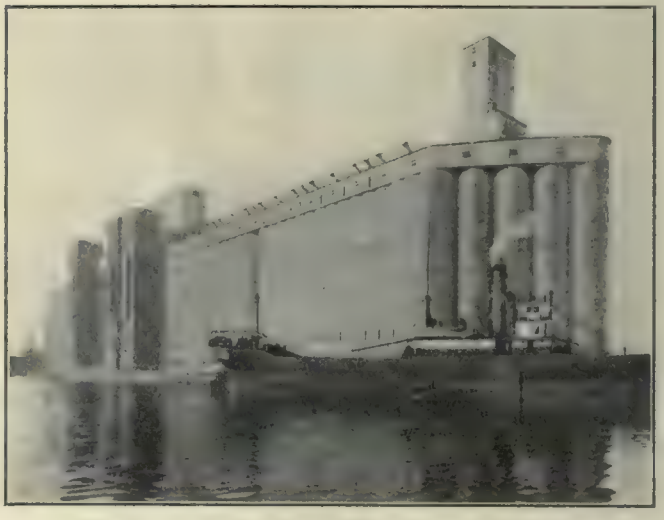

FIG. 3 CONCRETE GRAIN ELEVATOR AT BUFFALO

in general remained practically the same. Hence it is by no means always the case that the first cost of a concrete building will be greater than that of a building of wood. Brick and concrete are apt to cost about the same, while in most localities steel is more expensive.

But the far-sighted executive looks beyond first cost and weighs other things which may in time assume greater importance in the problem. Some of these will now be considered.

Maintenance. Maintenance of a structure includes painting, cleaning, and such repairs and replacements as are necessary to keep it in a condition fit for efficient use. Rust and rot attack the main members of many buildings in places difficult or impossible to reach with paint, protective coverings, or replacements, and the structure is inevitably doomed. In concrete construction, rust and rot lose their destructive power, as concrete is unaffected by dampness or atmospheric conditions. No painting is needed. Instead of wearing out, it grows stronger with the passing of time. Cost of repairs is negligible.

Depreciation and Obsolescence. Many structures undergo a gradual aging or depreciation until finally they must be retired and new ones built. Obsolescence, of course, refers to the eventual outgrowth of the present quarters through changing methods and standards, and perhaps change in surroundings. In allowing for depreciation and obsolescence, a sum is set aside each year for the purpose of building the new structure which must eventually replace the old one. In con-

crete construction, depreciation ceases to be a factor. Obsolescence is minimized because a well-planned structure ordinarily can be adapted to quite diverse uses, so that it can be sold to advantage if it is outgrown.

Fire Resistance. The total value of fire resistance in a building cannot be readily estimated in dollars and cents (although insurance savings can be definitely computed) as it depends on various elements. Not only does fireproof construction lower insurance rates, but it protects against non-insurable losses, such as impaired credit, stopping of output, and loss of customers.

Insurance rates are invariably lower on fireproof structures, such as concrete, than they are on combustible buildings. Some insurance companies allow on reinforced concrete buildings 40 per cent reduction in rates below those set on inflammable types of construction. In general, rates on concrete structures are very low. As a matter of fact, some owners of concrete buildings carry no insurance at all.

Estimates were recently made of insurance rates on mill, brick and concrete construction for a three-story storage building in Chicago when the owners were choosing a type of construction. Rates quoted by one company on the building alone, without installation of sprinklers, showed an average rate of $0.47 per $100 valuation per year for the mill and brick construction, and a rate of $0.16 for the concrete building. Rates on contents showed a 50 per cent saving in favor of the concrete construction.

Business relations may be seriously jeopardized if

FIG. 4 CONCRETE WAREHOUSE IN TOKIO
Saved $4,000,000 worth of silks from earthquake and fire.

an industry is housed in a structure which may readily be destroyed by fire. Uninterrupted operation is necessary if a concern is to meet its obligations. Fire may defer or totally destroy the power to do so, thus greatly damaging credit and good will. Other fire losses include decreased return on capital investment and disruption of personnel.

Concrete Buildings in Japanese Earthquake. The behavior of concrete buildings during the Japanese earthquake is of considerable interest. In Japan, reinforced concrete had been used for about 15 years, steel construction about five, and brick and wood for centuries. All four types were studied by an American engineer, H. M. Hadley, who went to Japan especially for that purpose.

He found that some wooden buildings, due to the skill of the Japanese carpenters, stood up well, but added the grim statement: "In the fire-swept areas, all evidence was destroyed." He states: "Brick failed totally and was responsible for great loss of life." Brick also failed when used for curtain walls in structural steel buildings, and many of these collapsed, although those structural steel buildings in which reinforced concrete was used for the walls resisted the convulsions of the earth and were practically undamaged.

Reinforced concrete buildings, according to the report received by Mr. Hadley from Y. Nagata, chief engineer of Tokio, showed highly satisfactory results. Out of 592 concrete buildings in the earthquake zone, 462, or 78 per cent, suffered no damage whatever. The rest were injured in varying degrees, but only eight collapsed. Even better results would have been obtained, according to Mr. Hadley, but for the lower grade of materials used in making concrete in Japan and the faulty principles of design used in some instances. (See Fig. 4.)

Vibration Resistance. Where rapidly moving machinery is to be installed in a building, special attention should be given to the type of construction chosen, as great efficiency will be gained if vibration is reduced to a minimum. A machine anchored to concrete in a concrete building is part of the structure. It stays "put." After it is once adjusted and its shafting aligned, it remains in perfect running order, due to the lack of vibration.

Actual tests have shown increased production from machinery installed in a concrete building. Revolving printing presses have been run 20 per cent faster and manufacturing machinery 15 per cent faster in such buildings. This vibration resistance of concrete has led designing engineers specializing in textile mills to specify reinforced concrete as the best type for such buildings. It leads directly to a quicker turnover of material and a bigger yearly output.

Sanitation and Lighting. Concrete construction

FIG. 5 CONCRETE "DAYLIGHT" CONSTRUCTION IN TEXTILE PLANT

lends itself readily to sanitation and comfort. Floors, beams and columns have no crevices where filth or germs may lodge, and their solid construction leaves no holes for rats. The dense surface of concrete floors is non-absorbent and may be readily cleaned with water with no chance of damage to the floors below. Concrete, being a lime product, is antagonistic to germs.

Sunlight is also a warrior against germs, and concrete construction lends itself readily to large window space through the narrowness of its columns. The concrete factory is a "daylight factory." From 50 to 85 per cent of the wall area of a concrete building may be used for windows, running in many cases from floor to ceiling. This increases the efficiency of workers, according to estimates, from 5 to 10 per cent. Economy is effected through saving in expensive wall construction, and also in illumination. Better ventilation is obtained through the numerous windows. (See Fig. 5.)

Comfort. The concrete building is cool in summer and warm in winter. These qualities depend largely on the resistance of the walls to the passage of heat. In winter, there is an economy in heating through lower coal bills. In summer, the expense of maintaining cooling devices is often made unnecessary. Concrete walls are also impervious to moisture if properly constructed.

Strength. The strength of concrete is so well known as hardly to need mention. It also compares favorably with stone both in strength and durability. Concrete floors have been designed capable of resisting the enormous floor load of 5000 lb. per sq. ft.

Adaptability. The adaptability of a structure is of prime importance. In this respect concrete shows a clear advantage over other types of material. Designed for loads much lower than it actually will carry, and growing strong with age, a concrete building may be used for purposes varying radically from those for which it was originally built.

Instances of Adaptability

An instance of the adaptability of concrete is given by the building of the Kindel Bed Company, Long Island City, New York., which was originally designed for a floor load of 200 lb. per sq. ft. Due to changing conditions it was converted into a warehouse, where its floors successfully withstood a test load of 1200 lb. per sq. ft., or six times the load they were designed for. Such a performance would have been impossible for any other material.

Another phase of the adaptability of a concrete building is the ease with which it can be moved to a new location. Its one-piece construction gives great rigidity and insures against damage in moving. An instance of this is the moving of the three-story office building of the Hyatt Roller Bearing Company in Detroit. This building was moved 450 ft., bridging trolley tracks on the journey, while the office force carried on work just as usual.

Changes within the building may also be easily made. Where provision must be made for anchoring machines, shafting and similar equipment, insets and channels can be placed in a concrete building at suitable intervals to provide for a variety of arrangements.

The question of time required to construct a new building looms larger and larger as business operations expand and capital investment increases. Quick construction means a shorter tie-up of capital and quicker return from the investment. Concrete construction is speedy, due to the availability of the materials used, the simplicity of building methods, and the steady supply of labor. For example, last year 12 stories of the 19-story concrete Cooperative Apartment Building in Chicago were erected in 30 days' time. A stove factory in Buffalo, New York, 250 ft. long, 56 ft. wide, and two stories high, was built of concrete in two months.

Cement, sand and stone—the materials used in concrete—are found at short distances from nearly every building site. There are no delays while waiting for fabricated parts to arrive. Construction involves no intricate processes, and the unskilled laborers who mix and place concrete may be hired anywhere. For these reasons contractors usually estimate a lower figure for contingencies.

Concrete for Floors and Driveways

Concrete Floors. Concrete floors are almost entirely free from vibration, are fire-resistant, durable, smooth, clean and economical in upkeep. The blackened walls often seen standing alone after fire has gutted a building show the need of fireproof floors combined with concrete walls, which confine a blaze to its point of origin. Moreover, where water sprinklers or fire hose play on a fire, concrete floors, being watertight, prevent water from dripping to floors below and often doing more damage than the fire itself did.

Resistance to abrasion is important where floors are subjected to heavy traffic. The improved methods of curing concrete floors advocated by Professor Abrams have led to better wearing qualities of such floors, and they are entirely satisfactory under ordinary conditions. For heavy duty floors, a special finishing process is used with excellent results. It consists essentially of spreading trap rock on the newly-laid concrete, rolling with heavy rollers and rubbing the hardened surface with a grinding machine. The result is a smooth, durable, dustless floor.

Industrial Driveways. Outside the building, concrete may also be used to good advantage. Here industrial driveways and roads give year-round service, speeding up traffic by preventing tie-ups due to mired trucks, and saving gasoline and repair bills. The Ford Motor Company at Detroit has concrete driveways throughout.

This article has, of course, merely touched upon a few of the uses and advantages of concrete. In individual cases there are many additional factors which it offers to the manager who is looking for the best and most economical structure for his purpose. The growth of the cement industry and the increasing number of quarries and sand pits put in operation to produce crushed rock, gravel and sand, indicate the importance of concrete as a material of construction.

$15,000,000 Salvaged by Ford Plants

Methods of Reclaiming Waste Save $7.50 On Each Car Produced

By GEORGE E. HAGEMANN

Associate Editor, MANAGEMENT AND ADMINISTRATION

TOOLS, shop equipment and scrap metals are not the only items put back into use again by the 1000 or more men engaged in reclamation work at the Ford plants in Detroit.[1] The materials and articles salvaged cover a far wider range, as the following typical illustrations show.

Factory floor sweepings, totaling 3 tons daily, contain materials of value, especially nuts, bolts, cotter pins, borings, turnings and punchings, from 300 to 500 small towels each day, and occasionally lost small tools. Hence these sweepings are gone over to remove such portions of their contents as can profitably be reclaimed by sorting. The sweepings are then shoveled into trucks and taken over to an incinerating plant. Here they are dumped into a conveyor located in the basement and are delivered to boilers for use as fuel.

FIG. 1 VIEW IN THE LUMBER SALVAGE DEPARTMENT

Waste strips cut from material for automobile tops are assorted to various sizes and made up into hand pads, bags, miscellaneous covers, etc. The balance is baled up and sold as scrap. Narrow ribbon scrap is used for tying, replacing rope and twine.

Odds and ends of carpet and upholstering materials are used in packing, especially for export shipments of such parts as fenders, which have to be carefully protected to prevent scratching and denting. Scraps of upholstery material are baled and sold. Cotton shoddy is reworked into upholstery.

Cutting oils, extracted from borings and turnings, are passed through centrifugal separators. In this manner all dirt and foreign substances are thrown out and the clear oil is delivered to tanks for re-use. The average daily quantity handled is 2000 gal. from 25 tons of turnings. Oil used over and over again after going through separation has no effect upon the skin of machine operators, as is the case sometimes with new oils. The reclaimed oil is thoroughly pure.

A considerable saving is made from the reclamation of paint. Odd lots of this material which would ordinarily be thrown out are combined and mixed with linseed oil and turpentine and used over again. About 1000 gal. per day are reclaimed.

The hyposulfite of soda fixing solution used in developing photographic plates and motion picture film yields silver to the value of about $10,000 a year. The hypo is treated with sodium sulphate, which precipitates the silver nitrate. The liquid is evaporated off, the residue baked into cakes and sent to silver refineries for the reclamation of the metal.

There is a large butcher shop run by the Ford plant in Highland Park to serve its employees. From this shop great quantities of fats are obtained daily. These are rendered into tallow and refined in the reclamation department, made into cakes and used for polishing and finishing automobile parts.

Rubber boots and leather shoes with wooden soles are worn by many of the men engaged around the plant, the former in wet places, and the latter where hot metal is handled. These are repaired in the salvage department. First of all they are sterilized by baking with steam. Then the shoes are patched where necessary, and new wooden soles and heels are attached.

[1] See MANAGEMENT AND ADMINISTRATION, June 1925, pp. 557-560, for a description of reclamation work on these items.

The boots, when torn in the legs, are mended with layers of rubber and canvass attached by a special rubber composed partly of Fordite. They are then cured and are ready for service.

Hand pads are made from scraps of auto top material, several layers of which are sewed together with a strap of the same kind across the back. Asbestos gloves for use in handling hot materials, especially where the ordinary hand pads might catch on fire, are repaired with patches on sewing machines in a department adjacent to the shoe and boot reclamation room. When too far gone for repairing, these gloves are used as linings for hand pads.

Asbestos Gloves

New asbestos gloves are made at the plant more economically than they can be bought outside. The sheet asbestos is cut to size and shape and two pieces are laid together to form one glove or mitt, which is then sewed around the edges. The operation of turning the mitt right side out was found to consume a lot of time, as the material is stiff and unyielding. Consequently, compressed air was piped to the bench, and after the glove has been partially turned by hand and fitted over a nozzle, the air is made to complete the operation. Finally, the thumb is turned right side out on a smaller nozzle.

Out of a conglomerate mass of unpromising stuff—old mortar and plaster, clinkers and burned-out firebricks, scrap asbestos trimmed from gaskets, and just plain rubbish—together with a few other necessary ingredients, a salvage force of six men at the Highland Park plant manufactures five useful products and, in the process, saves one by-product.

Cinders, old mortar and plaster are dumped into a slag crusher located in a hole near the building, ground and sent aloft on a belt conveyor. A magnetic separator causes the metal bits which may be mixed with the refuse to cling to the belt and drop through a chute into a trailer placed below. The crushed material is graded according to size in a rotating sieve. The finished product is stored in a hopper, ready to be used for filling holes in roads, for serving as a first layer in grading operation, and so forth.

Scrap asbestos, coming principally from the gasket job at the Highland Park plant, is shredded and mixed with Ford cement, Kenner clay and Manistee sand. The result is a somewhat course asbestos cement, used as the first coat in pipe covering or boiler lining.

For a finish coat, the scrap asbestos is mixed with magnesia and Sil-O-Cel. A mixture of Manistee sand and Kenner clay is also made in the department. These are mixed wet to form cupola mud and ladle lining for the River Rouge foundry.

Firebricks

Burned-out firebricks are hammered free of whatever blackened crust may adhere to their surfaces. Only the sound lumps are kept; the rest is used as filler. The sound lumps are thrown into the slag crusher and sent aloft on a conveyor, like the rubbish above described; but the adjustment of a damper drops the brick fragments into a pan at this point. The pan is equipped with grinding wheels which pulverize a great deal of the brick; the rest goes through the same process over again until the entire lot is almost as fine as powder. Once a month this material is taken away for experiment. The coarser pulverized brick is known as ganister, and is used for furnace construction.

FIG. 2 REMOVING NAILS FROM SCRAP LUMBER

Boxes and crates for the shipment of Ford products have been standardized and reduced in kind and size from 600 to 45. Fourteen kinds and sizes suffice for 95 per cent of the products. The adoption of these standards has made possible an exceptional economy in the reclamation of wood coming into the plant from various sources.

All of this wood is gathered and delivered to the salvage department. Each day over 10,000 crates, boxes and cases, received from outside manufacturers, or returned from branches (which are required to get practically all of their necessary lumber from used boxes and crates, and to save up the remaining wood for return to Highland Park) are repaired and used over again for shipments. More than 200,000 ft. of new lumber and 300,000 ft. of reclaimed lumber are used for packing purposes each day. The total daily output of boxes and crates is now 15,000. About 5000 per day have been replaced by burlap bags.

The Highland Park plant salvages over 90,000,000 ft. of lumber annually. Every day between 200 and 300 trailers, each containing from one to three tons of lumber, used boxes, crates, etc., arrive at the entrance to the lumber department. This department is housed in a building about 80 ft. wide and 700 ft. long. (See Fig. 1.) Up each side about 15 ft. from the wall a belt conveyor system runs from end to end of the building. The contents of the trailers are piled on these moving conveyors. Wood-working machines are located on each side of the conveyors all the way up the room, and the pieces of lumber, varying from small strips a foot or so in length to 16 ft. boards, heavy railroad ties, and similar timber, are taken off at the machines where they can be most conveniently worked. Boxes are likewise removed and repaired.

Reclamation of Lumber

Ties and timbers of like proportions are run through saws, cut into boards and then planed. The ordinary strips of wood are replaned to remove damaged surfaces. If there are any nails in the lumber they are extracted by cutting off the bent portion on a specially fitted punch press, which leaves about ¼ in. protruding, and then striking the protruding end on a flat iron table. (See Fig. 2.)

If the nail heads are broken off, two terminals of a 220-volt, 7 amp. electric circuit are applied to heat the nails, char the surrounding wood, and thus allow them to drop out. Spikes are removed by a similar process. Where it is possible to reach only one end

FIG. 3 SEPARATING BLOCKS OF WOOD NAILED TOGETHER

of the metal, application of an acetylene torch for 30 seconds does the work.

Where heavier pieces of lumber are nailed together, one piece is clamped in a vise while the other is gripped by a pair of tongs attached to an overhead hoist. Raising the hoist pulls the pieces apart and the nails are removed in the manner already described. (See Fig. 3.)

FIG. 4 STORAGE YARD FOR BOXES

Pieces of wood when freed from nails and split up and planed are put back on the conveyor and travel up the line to workmen who assemble them to form box sides, ends, bottoms and tops. As the pieces of correct length come along, each workman removes those of a size suitable for his particular job and saws them to proper length. He assembles enough to form the correct width for the part of the box which he has charge of making. The last strip he adds is usually just a trifle wider than necessary. Consequently, he saws it off along its length after laying it alongside of the others so that he is sure to have the correct total width.

These assembled mats are stacked alongside of these sawing machines and are then moved to the box-making machines, where they are nailed together to form complete boxes, less cover. The boxes are than placed on the conveyor and go up to the end of the room, where they are taken off and delivered to the various production departments by trucks, or to storage by means of a belt conveyor. (See Fig. 4.)

All scraps of wood are thrown back on the conveyor and likewise go up to the end of the department, where pieces of an appreciable size are thrown into barrels. The remaining scraps fall into a grinder and are reduced to sawdust, which is carried by pneumatic conveyor to a storage bin outside of the building, for use on wet and oily floors. Eventually this sawdust gets into the factory sweepings and is burned for fuel.

Crate parts and braces are cut to size in the reclamation department and sent to the point of use for assembly. The radiator assembly department utilizes 22 pieces of wood in each crate, and 2500 crates are sent out each day. For carload shipment of motors 750 pieces of heavy packing and bracing lumber are required. As 70 to 80 carloads go out each day, the total requirement is 55,000 to 63,000 ft. daily. The

TABLE 1. MATERIAL RECEIVED AND RECLAIMED BY SALVAGE DEPARTMENT AT HIGHLAND PARK DURING ONE DAY

GOODS RETURNABLE TO SHIPPERS:	
1215 reels	
290 drums	
8 cases	
11 crates	
4 boxes	
42 wood barrels	
60 cyanide cans	
Value of material returned to shippers	$7157.45
also	
179 boxes	
125 cartons	
225 cases and ends	no charge
WASH TANK RECEIPTS:	
1000 lb. yard scrap	
1200 lb. shoveling scrap	
Value of material returned to stock	$ 147.50
T. B. DEPARTMENT RECEIPTS:	
500 lb. shoveling scrap	
50 lb. busheling scrap	
1000 lb. mixed metals	
1500 lb. scrap glass	
Value of material returned to stock	637.50
BELT SALVAGE RECEIPTS:	
3000 lb. scrap belt	
Value of material returned to stock	1045.09
Value of asbestos mitts and hand pads	166.20
VALVE SALVAGE RECEIPTS:	
900 lb. cast-iron scrap	
300 lb. red brass	
30 lb. shoveling scrap	
Value of material returned to stock	280.47
TOOL SALVAGE RECEIPTS:	
1400 lb. heavy melting scrap	
1900 lb. shoveling scrap	
3500 lb. high speed steel	
Value of material returned to stock	2838.45
TOOL REPAIR RECEIPTS:	
1060 lb. heavy melting scrap	
195 lb. shoveling scrap	
130 lb. busheling scrap	
434 lb. copper	
160 lb. malleable iron	
180 lb. yellow brass	
375 lb. cast iron	
Value of tools repaired	672.68
STORAGE DOCK RECEIPTS:	
4000 lb. yard scrap	56.92
OIL SALVAGE RECEIPTS:	
50,000 lb. steel turnings	
Value of oil reclaimed	168.85
PAINT SALVAGE RECEIPTS:	
500 gal. scrap paint	
Value of reclaimed paint put in stock	250.00
Value of material sold in salvage stores	125.00
GENERAL SALVAGE RECEIPTS:	
720,000 lb. steel turnings	
320,000 lb. baled steel	
4,000 lb. baled Terne plate	
10,000 lb. galvanized scrap (baled)	
10,000 lb. baled wire and hoops	
250 lb. baled tin	
340,000 lb. baled cast-iron borings	
120,000 lb. malleable iron turnings and borings	
40,000 lb. mixed turnings and borings	
50,000 lb. butt ends	
85,000 lb. flashings	
135,000 lb. busheling scrap	
85,000 lb. shoveling scrap	
24,000 lb. heavy melting scrap	
18,000 lb. steel discs	
17,000 lb. cast-iron scrap	
12,000 lb. unbreakable castings	
6,000 lb. burnt iron scrap	
4,000 lb. malleable castings scrap	
3,600 lb. magnet scrap	
40,900 lb. miscellaneous steel scrap	
900 lb. high speed steel turnings	
100,000 lb. slag concrete, etc.	
24,000 lb. bronze borings	
4,000 lb. factory sweepings	
1,500 lb. aluminum bronze borings	
1,000 lb. babbitt ash	
1,500 lb. solder ash	
1,700 lb. babbitt and iron skimming	
400 lb. sodium lead dross	
480 lb. mixed white metals	
600 lb. copper and solder borings	
7,200 lb. copper baled	
5,760 lb. copper slugs and miscellaneous scrap	
9,830 lb. baled yellow brass	
1,755 lb. solid yellow brass scrap	
6,800 lb. brass to be washed	
2,420 lb. phosphorus bronze bushings	
7,615 lb. yellow brass borings	
730 lb. scrap lead	
3,885 lb. scrap red brass castings	
3,760 lb. scrap babbitt	
4,000 lb. brass borings from Lincoln	
1,175 lb. dirty and mixed brass borings	
160 lb. scrap brass from Lincoln	
295 lb. brass buffings	
295 lb. aluminum oxide	
180 lb. special sweepings	
210 lb. brass and sand blast	
350 lb. scrap battery plates	
200 lb. excelsior	
2,000 lb. paper	
2,000 lb. asbestos	
100 lb. magnesia	
50 lb. rubber	
1,400 lb. burlap	
300 lb. white rags	
200 lb. black rags	
300 lb. miscellaneous rags	
50 lb. rope	
200 lb. scrap leather belting	
1,000 lb. carpet cuttings	
3,000 lb. artificial leather	
2,500 lb. artificial rubber	
The above material is distributed as follows:	
Sent to foundry	$ 3,481.69
Sent to River Rouge plant	2,581.08
Outside sales	11,090.71
Daily credit to salvaging department of material returned to stock from dismantling jobs	4,578.70
Babbitt reclaimed each day	1,371.19
Total daily weight of material received	2,326,760 lb.
Total value of material going daily from salvage	$ 36,649.84
At this rate during the year in which this day's material was collected, the total value of material per month was	952,898.44
And the total value of material per year was	11,434,781.28

planks are 8 ft. 6 in. long, and formerly had to be made from new timber. A metal splice devised about a year ago now permits the joining together of shorter lengths for the purpose.

Small pieces of hardwood are cut into blocks about $\frac{5}{8}$ by 1 by 6 in., through which two holes are drilled perpendicular to the long side. These blocks are then assembled with long $\frac{1}{4}$ in. rods into mats 18 by 36 in. in size, for use in wet places around the plant.

All burlap coming into the plant is collected and sent to the reclamation department. Here it is sorted out and reissued for use as packing material, either to fill empty spaces in boxes, to head barrels, or to make bags and bundles.

All corrugated board received in the plant is salvaged. Large pieces are used for packing automobile parts in boxes and crates. Including wrapping paper, about 2000 lb. of such material is salvaged daily.

Wrapping paper in large and medium-sized sheets is saved for re-use. Likewise, rope and twine are salvaged and used over again.

Throughout the plant there are located large receptacles for the receipt of waste paper, beside each of which there is a box for food refuse. Employees are required to separate the latter when eating lunches, fruit, etc., and deposit it in the proper box. All paper from lunches, candy, fruit, miscellaneous scraps of wrapping paper, cardboard, and the contents of the office waste baskets are collected daily and delivered to a large baling machine. More than 6 tons are baled in two shifts of 8 hr. each. After baling, this material is delivered to cars which carry it to the paper mill at River Rouge.

An average day's savings from reclamation are listed in Table 1.

As the Ford Motor Company turns out over 2,000,000 cars per year and reclamation conserves $15,000,000 worth of material, it is evident that the total savings per car by means of this work are $7.50, a truly remarkable figure, approaching close to 2 per cent of the selling price of a fully equipped auto. At the same time many men are being restored to normal health in the performance of this work.

The reclamation department of the Ford Motor Company is accomplishing successfully a task of immense proportions, and one profitable from the standpoint of the company, the employees, the consumers, and industry and society as a whole.

Welding Applied to Motor Production

Methods Followed Give Better Results at Less Cost

By J. F. LINCOLN

Vice-President, Lincoln Electric Company

THROUGH the application of the patented "Linc-Weld" process of electric arc welding, the Lincoln Electric Company has been enabled to develop mass production methods for a new steel motor, the only one of its kind on the market. The motor replaces the older type made by the company, which employed cast iron or cast steel in its frame.

New Methods the Result of Research

The new product and its methods of fabrication are the outgrowth of many years of research and experimental work on the part of the firm's engineering force. They bring into use many factors which are, in fact, radical steps compared to usual present-day methods of manufacture in the metal industries. Back of the years of experimental work which the company has done, has been the guiding thought that if arc welding could be successfully applied to construction of the metal parts which enter into the electric motor, the firm would be able to make a motor of lighter weight, greater power, better ventilation and of an almost indestructible nature, at a cost no greater than that for the old style product built of cast iron or cast steel.

It has heretofore been impossible to apply rolled steel shapes successfully to machine products. But the use of such shapes means greater strength, greater stiffness and higher quality of product. The lower cost of the rolled steel permits manufacturers to make greater expenditures in the actual construction of parts. The possibilities of savings in material are indicated by the following figures: Standard shapes of rolled steel have at the present time a cost of approximately $0.025 per lb.; iron castings have a cost of $0.04 to $0.20 per lb., with an average of $0.06; drop forgings range from $0.10 to $0.40 per lb., with an average of $0.15; malleable castings have a cost of from $0.10 to $0.40 per lb., with an average of $0.15; steel castings have a cost of from $0.08 to $0.20 per lb., with an average of $0 12.

Rolled steel has a tensile strength of approximately 65,000 lb. per sq. in.; cast iron 10,000 lb. per sq. in.; malleable iron 30,000 lb. per sq. in.; steel castings around 50,000 lb. per sq. in. Rolled steel, therefore, has six times the strength of cast iron, twice that of malleable iron and slightly greater strength than steel castings. Because of the severe strains to which a motor may frequently be put, it is of prime importance to produce one which will afford the greatest possible resistance to distorting forces.

Steel has a modulus of elasticity half as great as cast iron, which means that if a shape is made from cast iron it will bend twice as much with the same load as if made of steel. In other words, the steel frame has twice the stiffness of one made of cast iron.

Castings for motors cannot be made in the best possible shapes to resist tensile and shearing stresses. They must be designed for convenient moulding and pattern drawing. Neither do the standard rolled shapes lend themselves to ordinary means of fabrication. But the new welding process has entirely eliminated the difficulties which were present before, and has made possible the shaping of structural steel parts into any form needed, and adapted them to practically any kind of machining. In some cases in the construction of the new Lincoln motor, the steel parts are united directly by welding. In other cases a rolling operation is necessary before welding. In still others, shaping, welding and then punching of holes are all required.

Changes Based on Good Management

The change in manufacturing methods has come about through specialization and attention to principles of good management. For 30 years the company has concentrated its attention upon the one problem of manufacturing induction motors. Through specialization and standardization, and now by the development of the present welding processes by which rolled steel is largely used in the frame construction, it has become possible to secure three times the output per dollar investment, and twice as much output per man, at only half the overhead per dollar outlay, as compared with manufacturing a wide line of motors of cast iron or cast steel.

The welded motor end rings for the frame are made from standard steel angle, instead of the usual cast iron. The entire operation of heating, shaping and welding of the end rings takes but a few minutes. The angle is first heated, then rolled to circular shape on a special machine designed at the plant and finally "Linc-Welded." The union is actually stronger than the original material.

The adoption of this type of end ring has cut out all breakage in manufacture, such as had been experienced in the past where cast iron was used. Breakage

in actual service is also eliminated. At the same time the weight has been considerably reduced, as comparison of the two types in Fig. 1 will show.

It has also been possible to introduce improvements in the design of the motor. Ventilating slots are punched around the circumference in order to remove obstructions to the passage of air over the windings. These openings are larger than can be safely introduced in a cast-iron frame, where 2½ times as great a cross section of metal is required for the same strength. Consequently, an element of safety has been

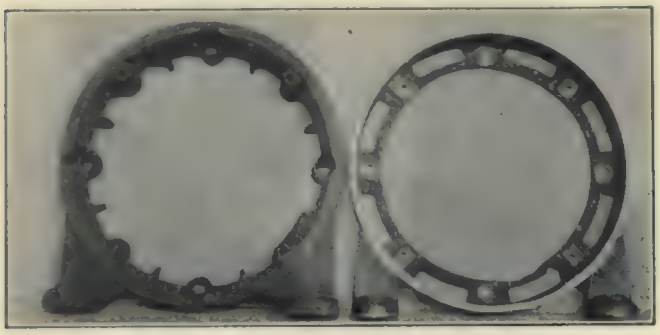

FIG. 1 OLD AND NEW STYLE END RINGS
Cast-iron type on left, new welded-steel type at right.

obtained, in that the motor is more readily cooled and is able to stand overloads without much danger of burning out.

In making the stator, thin sheets of steel, or laminations which make up the magnetic field, are stacked and put under heavy pressure between two steel end rings. While compressed in this way they are hot-riveted together. As the metal cools it contracts, and the laminations are held so firmly between the end rings that it is practically impossible for them to work loose under any conditions. Such a method of manufacture is possible only where steel is used in the end rings. The ordinary cast-iron frame would break under the pressure.

In the construction of the rotor, steel has also been applied in order to get the best possible results. Here again the laminations are first assembled between two heavy steel end plates and then placed under pressure and hot-riveted. The windings or copper rods are not depended upon in the rotor to hold laminations together. Many motor failures in the past have been due to placing a strain on the copper or aluminum windings, which have been supposed to hold the laminations. Rotor strains on windings are impossible under welded construction.

The rotor has offered in the past one of the greatest problems to motor manufacturers. The difficulty has been to join the rods and end rings in the rotor so that the union would be perfect and the current would flow readily. Improper union between rods and end rings has been responsible in many cases for heating, poor operation and often complete failure of the motor.

Efforts have been made to overcome these difficulties in the rotor through the casting of the two parts in one solid piece. Brazing and soldering have also been resorted to. But neither method brought about a satisfactory union. By means of the welding process, however, rings and rotor rods are perfectly united.

End rings are made from strips of pure copper, bent into circular shape and welded, in much the same way as are the steel frames. The end rings are then punched and put over the drawn copper rods, which have already been inserted in the motor, and which slightly protrude. At this point the entire rotor is placed in a specially designed automatic machine, where the rods and rings are welded solidly together. The result of this work is to bring the rods and end rings into one solid piece, and electrically to insure a perfect flow of current.

The welding process is also applied in putting the heavy ventilating vanes on to the rotor plate. Each vane is made a part of the plate itself, thus eliminating any possibility that it may come off and cut the windings. These vanes in conjunction with the enlarged air spaces in the frame, and a steel deflector welded to the inside of the end bracket, throw a current of air through the motor and add to its protection against overheating.

The feet of the motor are of drop forged steel, welded to the steel frame. A jig with a true plane surface is used for holding the feet and stator during the weld, so that the motor feet are always parallel to the shaft and will not rock when mounted on a true base. After the machine work on the frame is done, the feet are ground, to make certain that they are not only parallel to the shaft, but are at right angles to the frame. This is the first time that drop forged feet have been successfully applied to motor construction. Their great advantage lies in the fact that they do not break or bend and will stand all sorts of abuse.

Bearing shells for the motor are made of wrought

FIG. 2 WELDER AT WORK ON CONSTRUCTION OF MOTOR

FIG. 3 MANUAL LABOR IS ELIMINATED IN HANDLING
Conveyors carry motors to shipping department.

steel instead of cast iron. Hence they are both stronger and thinner in section, thus allowing for a greater amount of babbitt metal lining and for a larger shaft. The bearings in the end brackets are fitted into a seat in such a way as to prevent binding.

Welding has been applied to even one of the smallest parts of the motor. The oil rings consist of two dished steel rings welded together. The deep groove thus formed in the center of the ring carries oil to the top of the shaft and bearing in quantities 10 times as great as with a solid ring. Through the use of a baffle the oil ring is prevented from riding off or becoming stuck.

Steel end bracket bolts are used to make a rigid frame for the shaft bearings. The bracket bolts extend through the entire motor. The conduit box on the motor is welded from heavy sheet steel.

Throughout the plant careful attention has been given to efficient layout, and to the locating of individual machines so that the greatest possible amount of work can be accomplished with the least amount of effort. Much of the hand work involved has to do with welding processes. (See Fig. 2.) Wherever possible, machine operations have been substituted to eliminate hand work. Conveyors are also utilized to cut down operating costs. Some idea of the manner in which the completed motors are handled by the packing department may be gained from Fig. 3. They are carried along on a conveyor and simply picked off by the operator for crating.

The importance of the work carried on by the engineering force of the company, which has resulted in the perfecting of the welded steel motor, is measured by the fact that through the use of "Linc-Weld" process it has been possible to increase the capacity of the motors 25 per cent at no additional cost.

The day is not far distant when the application of arc welding will practically eliminate the need of patterns for making many manufactured articles, and also, in many cases, eliminate the use of riveted sections.

$20,000 a Year Lost Through Wrong Power Figures

By A. F. SHEEHAN

MANY industrial plants purchase power in the belief that they will save money, due to the widespread propaganda of central power companies concerning the economies of large-scale production, and the seemingly high cost of generating power in small plants of 100 to 1000 kw. capacity. But if a thorough investigation of costs is made, it is easily seen that the small industrial plant can often compete with the best public utility rates, even if its power plant is not so modern.

It is a well-known fact that the greatest single loss in a steam engine or turbine which exhausts into a condenser is the heat loss in the exhaust, which in public service plants is from 70 to 80 per cent. But in an industrial plant it is often possible, even with old engines, to use all the exhaust steam and thus eliminate the great condenser loss which the central station plant faces.

A paper mill in the east recently closed its own power plant and contracted to purchase central station power for $0.013 per kw-hr. This plant used 600 to 660 kw., with an average of 630 kw., and ran 24 hr. per day. The equipment consisted of three paper machines, motor driven, each motor having a capacity of 100 hp. The average load on these motors was around 80 hp. each, making the total load on the machines 240 hp., or 180 kw. Thus 180 kw. of the turbine output was used in the machine room while the rest of the mill required from 420 to 480 kw., according to variations in the load. The turbine was always in operation and, with the mill taking 480 kw. and the machine room 180 kw., ran under a 10 per cent overload, which it carried without any troublesome features, except increased steam consumption.

One of the reasons for changing over to central station service was that the owners considered the coal bill too high. The daily coal consumption was 28 tons. Since the average load was 630 kw. and the hourly coal consumption $\frac{28\times2000}{24}$ or 2333 lb., the owners assumed that the turbine used up $\frac{2333}{630}$ or 3.7 lb. of coal per kw-hr.

How the Mistake Was Made

The central station representatives insisted that the plant would save money by purchasing power from them and the management accepted this statement without making a thorough investigation. Had the real costs been ascertained, and had the mill owners insisted that the power company guarantee the saving

in an ironclad contract, much trouble would have been avoided.

Coal cost $7.20 per ton delivered to the plant boiler room. As 3.7 lb. of coal was burned per kw-hr. of power output, the apparent cost of fuel for power was $0.013 per kw-hr. Labor costs on each of the three shifts were: One engineer at $0.80 per hr., one fireman at $0.70 per hr., and one helper at $0.50 per hr. Their total hourly rate, $2, divided by 630 kw., gives $0.003 as the labor cost per kw-hr. The sum of these two amounts, $0.013 and $0.003, equals $0.016, the apparent cost of power per kw-hr., exclusive of interest, depreciation and maintenance.

When the owners were offered power at $0.013 cents per kw-hr. they assumed that a saving of $0.003 per kw-hr. would result. In an operating year of 300 days, 24 hr. each, the possible savings seemed to be $0.003×630×24×300=$13,608.

The first mistake they made, strange as it may seem, was in assuming that all coal burned should be charged to the power generating equipment. After the mill was operating on purchased power, it was found that 13 tons of coal were still required per day to supply steam for drying paper. Previously, exhaust steam at 10 lb. pressure had been bled from the second stage of the turbine and used in the machine room. This steam, of course, should have been charged to the machine room, in which case the calculations would never have been in error. Since 28 tons of coal were required per day when the turbine was running and 13 tons when the turbine was shut down and power was bought outside, the only coal that should have been charged to power was 15 tons per day. The cost accounting system was entirely wrong which had charged all coal and labor costs to the generation of power.

When the power was generated by the company's own plant a total of three engineers, three firemen and three helpers were employed on the three shifts. The daily cost for these men was $48. After the contract for purchased current was signed, the plant still needed one engineer, three firemen and one helper. So the total labor cost chargeable to power was really only that for two engineers and two helpers, at 8 hr. each, or $20.80 per day.

The following analysis shows what the real cost per kw-hr. was when the turbine was running and the company produced its own power:

The total kw-hr. generated in a year were 630×24×300=4,536,000 kw-hr.

Total fuel cost, before purchasing power, was 28×$7.20×300=$60,480.

Total labor cost, before purchasing power, was $48 per day×300 days=$14,400.

No capital charges are added, since the boiler plant has been installed 15 years, and the money invested in the turbine cannot be recovered by selling the machine at second-hand prices.

Since the fuel bill is now 13×$7.20×300=$28,080 when the turbine is shut down, this amount must be deducted from $60,480, which gives the real fuel cost of generated power as $32,400.

Present labor costs for steam, with purchased power, are: One chief engineer at $0.80 per hr., three firemen at $0.70 per hr. and one helper at $0.50 per hr., making the annual labor cost $27.20×300=$8160, which must be deducted from $14,400. This gives $6240, the total labor to be charged against turbine operation.

The net cost of generated power was therefore $\frac{\$6240+\$32,400}{4,536,000}=\$0.0086$ per kw-hr.

The actual power cost was thus less than 1 cent per kw-hr., yet a contract was signed to pay $0.013 per kw-hr. for current, which means that the company suffered a loss at the end of the year as follows: ($0.013−$0.0086)×630×24×300=$19,958.

Evidently this particular company needs the assistance of a high-grade engineer to install an accurate cost finding system and reorganize its power plant when the present contract with the power company ends. I do not know the length of time the contract has to run, but if it is a five-year agreement the company stands to lose over $100,000, figuring 4 per cent interest on the annual loss of $19,958.

Steam was generated at 180 lb. pressure and 100 deg. superheat and about 45 per cent of the total steam was passed into the drier after expanding down to 10 lb. in the turbine. Since a pound of steam passed through the high-pressure stage of the turbine developed 50 per cent as much power as the steam that expanded all the way through to the condenser, it is easily seen that 22½ per cent (0.50×0.45) of the total power was generated at practically no cost. This is due to the fact that the total heat in steam at 180 lb. pressure is only 4 per cent greater than at 10 lb. pressure, both at 100 deg. superheat. In addition, a large amount of live steam was used in the drier and in bleach boilers.

The officials of the mill do not like to admit that they made a bad move and will not state what the present plan of procuring power is costing. But this attitude only serves to strengthen the conviction that the financial loss is considerable and that they will not be caught in such a predicament again.

Errors in Power Cost Accounting Common

There are many other industrial plants that have fallen into this same error, namely, charging all coal and labor to power generation, instead of realizing that considerable coal must be burned to heat buildings and supply steam to manufacturing processes, such as drying, boiling and washing. A thorough cost system should be installed, so that if one department uses steam for certain operations, the cost of producing that steam will be charged to that department and not to the engine or turbine. If the steam passes first through the engine and then to some manufacturing process at exhaust pressure, at least 90 per cent of the cost of the quantity of steam used in this way must be charged to the process, and not over 10 per cent should be charged to the engine.

Increasing Power to Meet Demands

United Alloy Steel Corporation Has Added to Boiler Equipment for Present and Future Needs

By F. H. MOYER

Assistant to the Vice-President in Charge of Operations, United Alloy Steel Corporation

IN the fall of 1924, the United Alloy Steel Corporation, Canton, Ohio, made radical improvements in its rolling mill equipment which doubled production. At the same time it was necessary to increase the power output to meet the increased mill capacity, and consequently a new boiler house was built.

Previous to the construction of the new boiler house, steam was generated by using blast furnace gas, a by-product, in connection with coal, which was hand-fired; but the supply of this gas was inadequate to keep up steam to run all of the generating equipment constantly. Since the boilers were designed for the use of the two fuels together, they could not be operated efficiently to meet the increased demands by firing a larger proportion of coal. Moreover, the capacity of the boiler equipment was not sufficient to meet the new requirements. Hence, as increased power could be obtained from the generating equipment without difficulty if more steam were available, a new boiler house was decided upon as the best solution to the problem.

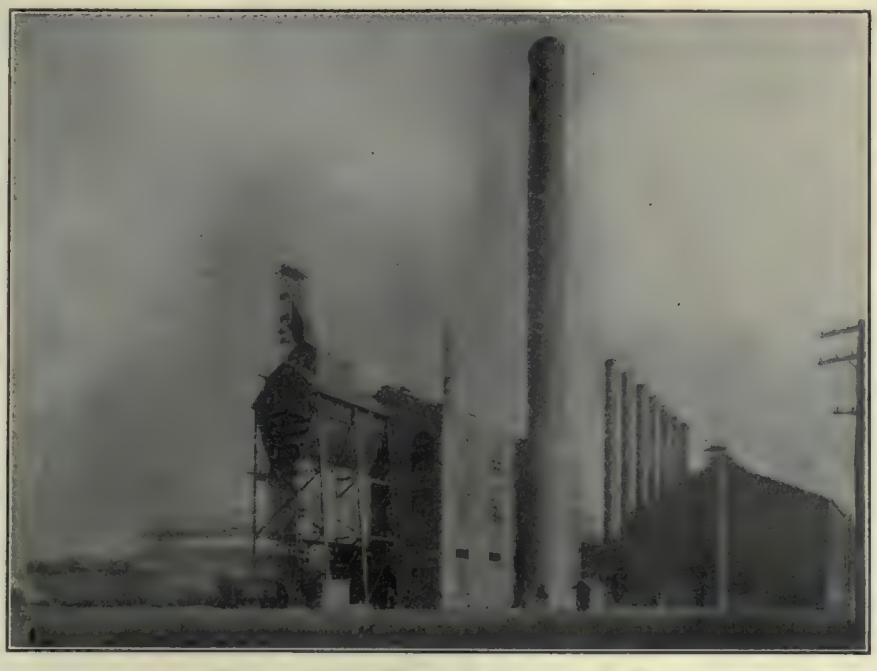

FIG. 1 GENERAL VIEW OF NEW BOILER HOUSE

The new plant is shown to the left in Fig. 1. The original boiler house, with its numerous chimneys, is immediately back of the new plant. The generating equipment is located in the building just to the right of the original boiler house, and shown in Fig. 1. The deep well pumps, the spray pond, and the creek from which the plant draws part of its water supply, are still further to the right. To the left of the old boiler house is located the furnace (not visible in the picture) from which the supply of blast furnace gas is obtained for fuel.

The new boiler house is 52 x 120 ft. and of brick and steel construction. Its equipment for the generation of steam consists of four 768-hp. Babcock and Wilcox boilers. Three are equipped with Riley stokers with three extra long retorts each. The fourth boiler has a Harrington traveling grate stoker 15 x 17 ft. in size. Over this is mounted an American suspended arch and firebrick furnace walls. This boiler is designed to burn all coke breeze, or a mixture of coke breeze and coal. The latter boiler and its stoker are in the foreground in Fig. 2, and the three remaining boilers are shown further down the room.

All the boilers have Babcock and Wilcox superheaters. Steam is generated at 210-lb. gage pressure and 100 deg. fahr. superheat. The four boilers evaporate a total of 195,000 lb. of water per hr.

Control of boiler room operation is maintained by a Hagan master controller and Hagan combustion control machines on each individual boiler. A system of Bailey boiler meters records steam flow, air flow and flue gas temperature on each boiler. The meters are visible in Fig. 2. Foxboro temperature recorders are used.

About 84,000 tons of fuel will be burned annually in the new plant. When operating the boilers in the older boiler room a force of 26 men, in three shifts, was required to run the equipment and fire the coal. The new plant operates with a fireman and a water tender on each shift, and a coal handler on one of the shifts, or a total of seven men. The total force in the entire power plant, including both boiler rooms, the

FIG. 2 BOILER FRONTS, SHOWING STOKERS AND COAL HANDLING EQUIPMENT

turbine room and the water treating plant crew, numbers 39, distributed as follows:

Engineers	6	Pump tenders	3
Firemen	6	Treating plant operators	3
Boiler attendants	6	Turbine room maintenance force	4
Coal handlers	1	Oilers	3
Ash handlers	1	Boiler house maintenance force	4
Turn foremen	2		

There are three shifts employed. On the day shift there are nine men in the boiler room and nine men in the turbine room.

The boilers operate under a combined natural and forced draft system, which is the most economical method for a large plant running its steam generating equipment at a high rating. The stack is of brick, 225 ft. high and 13 ft. inside diameter at the top. The forced draft equipment consists of four B. F. Sturtevant fans, three driven by 50-hp. motors and one by a 30-hp. motor. All are connected to a common header, but one serves the Harrington stoker-equipped boiler and another is a standby unit for emergency use. Beaumont soot chutes are located in the rear of each boiler.

Feed Water

Boiler feed water is obtained from deep well pumps located in the yard adjacent to the power plant. As the water abounds in calcium and magnesium salts, which form boiler scale, it has to be treated to precipitate these substances. The cost of purification is low compared to the maintenance work required on the boilers when scale is allowed to deposit in the drums and water tubes. The feed water treatment system was designed and installed by the William B. Scaife Company.

After treatment, the purified water is added as make-up water to the condensate from the turbines, and is passed through a Hoppes open feed water heater of 517,500 lb. per hr. capacity. No economizers are used. The feed water is supplied to the boilers by means of an Allis-Chalmers 4 in., 4-stage centrifugal pump, with a capacity of 600 gal. per min., and driven by a 175-hp. steam turbine. Copes feed water regulators are used.

An extensive coal and ash handling system has been installed. Bituminous coal from Ohio is used as fuel. Large coal storage yards, served by railroad tracks, are located in the northeastern part of the yard (about a quarter of a mile in the background of Fig. 1). Here coal is unloaded for storage by means of Bay City locomotive cranes operating grab buckets. From this point, or direct from incoming cars, it is delivered to the track back of the new boiler house, as shown in Fig. 1.

Handling Coal at the Boiler House

A large hopper is beneath the track and into this the coal is dumped. An R. H. Beaumont skip hoist with a capacity of 60 tons per hr. carries the coal up to roll crushers, from which it drops into an overhead storage bin of 250 tons capacity outside of the boiler house (see Fig. 1). Adjacent to this is a 90-ton bin to hold coke breeze for the boiler with the Harrington stoker.

A 2-ton traveling weigh larry (see Fig. 2) for supplying coal to the boilers is also of Beaumont make. It is loaded at the storage bin and delivers coal to hoppers over each stoker. Each of these hoppers holds a normal four-hour coal supply at 200 per cent rating. One man on one shift handles all the coal required.

Fig. 3 is a view in the rear of the boilers.

The boiler room floor is about 26 ft. above ground level. This elevation was made to facilitate ash handling. Each boiler is equipped with Beaumont ash

FIG. 3 REAR VIEW OF BOILER SETTINGS ON FIRING FLOOR

and sifting hoppers located beneath the stokers. Standard gage gondola cars are run under these hoppers, as shown in Fig. 4, and the ashes are discharged into them. The railroad track under the boilers is 16 in. below the yard level. When filled with ashes, the cars are pulled out, switched onto the main line and taken out of the yard or to the ash dump. One man is required for only a part of the time to handle the removal of ashes.

The generating equipment, all of which can now be run as needed on account of the increased boiler capacity, consists of one 7500 kw. and two 3000 kw. General Electric (Curtis type) turbo-generators, running, respectively, at 1800 and 3600 r.p.m., under 200 lb. steam pressure and 100 deg. fahr. superheat. The average steam consumption of the turbines is 16.2 lb. per kw-hr. The overall economy of a turbo-generator station is appreciably increased by the use of super-

FIG. 4 ASH HOPPERS AND ASH CAR

heated steam, and its application in plants of moderate and large size has become common practice in modern plants.

No steam is used throughout the plant for processing and the small quantity required for heat in winter is obtained from the exhaust of the steam-driven air compressors in the power house. Consequently bleeder type turbines, or the operation of any considerable portion of the equipment non-condensing, or the installation of heating boilers in the power house is not necessary.

Five Wheeler Condensor and Engineering Company surface condensors are installed, one with 18,000 sq. ft., two with 6700 sq. ft., and two with 4100 sq. ft. of condensing surface. Pumps of Wheeler make handle the condensate and air. The circulating pump has a capacity of 12,000 gal. per min. and is driven by a 225 hp. steam turbine, through reduction gearing.

The plant is located along a creek, but the water supply has to be considerably augmented by deep well pumps. Hence, the condensate from the turbines and the cooling water from the condensors have to be saved and reused. Ample space on low-cost land made the spray method of extracting heat from the cooling water the most economical to operate. A Yarnall-Waring system has been installed for the purpose, to the south of the power house.

Both alternating and direct current are generated. The voltage on the alternating current lines is 11,500 on the circuits to the steel plant. This voltage is stepped down to 2300 for the larger motors running the mills and 250 for general service motors. The lighting line voltage is 115. Transmission lines are overhead in some cases and underground in others. An average of 8,500,000 kw-hr. is produced monthly.

Auxiliary power equipment which is steam-driven includes compound steam, single stage (two cylinders) air, Mesta blowing engines, 34 x 72 x 84 x 84 x 60 in. stroke, 60 to 70 r.p.m, run condensing and having a steam rate of 15 lb. per i.hp-hr., and Ingersoll-Rand two-stage air compressors 19 x 34 x 32 x 20¼ x 27 in. stroke, 80 to 120 r.p.m., with a steam rate of 20 lb. per i. hp-hr. The exhaust from the air compressors is used for feed water heating.

Problem of Future Operation

Every manager is confronted with the problem of the future when he commits himself to an investment in equipment. The larger the outlay and the more highly specialized the equipment, the greater the risk involved. Future operating economy must be taken definitely into account, as well as present running expense. Each question must be carefully considered before a decision is reached. Only by weighing the proportionate influence of each factor and combining them all in their proper respective ratios can a policy be determined which will work out with a reasonably close approach to expectations.

The problem in connection with the boiler house equipment in the present case was partly one of fuel. The immediate occasion of the building of a coal-fired plant was the inadequacy of the blast furnace gas supply, and the inability to operate the old station efficiently by increasing the ratio of coal used there. But economy dictated the continued use of such of the blast furnace gas as was available, and hence a separate coal-fired station was the best way to meet the increased steam requirements.

Provision for Blast Furnace Gas

However, in the normal course of events, a point will be reached in the company's growth when another furnace will have to be added. This furnace will generate, as a by-product, a considerable quantity of blast furnace gas. To utilize this gas, plans have been made for its introduction as fuel in the new boiler house. Each of the three coal-fired boilers is so designed that an additional combustion chamber can be installed at the rear to burn blast furnace gas. In this way either the coal consumption of the plant will be cut down, or more steam will be generated by operating the boilers at a higher rating.

The power station, as operated today, is an economical unit. The two boiler houses operated together provide ample steam for running the generating plant, and the current available answers all power demands. Substitution of mechanical equipment, in the form of stokers and coal and ash handling apparatus has reduced operating expenses considerably below the cost of an equivalent output in the older plant where hand labor was used for the purpose. If blast furnace gas is used at any time in the future in the new boiler plant, the station will operate with even lower costs.

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 100 magazines; it also includes the publication of some 50 book publishers and professional societies as far as these are of managerial interest to industrial executives. The decimal number at the right of each item is the index number according to the Dewey Decimal Classification System and indicates the place the article or book will take when filed in accordance therewith in the classified subject scheme. If articles are grouped according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. Photostat copies of any magazine article indexed will be supplied by Management and Administration Corporation within a year following the date of publication at a *price of 25 cents the page.* When ordering photostats please identify the article by quoting from the index: (1) Title of article; (2) Index number; (3) Name, date, and page number of periodical in which the item appears. A remittance of 25 cents a page should accompany the order. The books and pamphlets indexed can be procured from Management and Administration Corporation or from their respective publishers.

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National Fire Protection Association, Boston. Leaflet. 24 pp. Report of Committee of Association containing tentative specifications for ground supported vaults, for vault doors, a schedule for retention of records, and a classification of records.

Scientific Industrial Management. 658
Fred W. Shipley. Bankers Trust Company, New York. Leaflet. 31 pp. Discussion of management principles, emphasizing necessity for budgetary control. Experiences of several manufacturing concerns used to illustrate various points.

Visible Management Methods Increase Output. 658.51
J. M. Cronin and H. F. Van Wye. *Textile World*, May 23, 1925, pp. 35-37. Illus. Planning methods and control used in a tapestry mill to give maximum output, minimum waste, and prompt deliveries.

The Young College Man's Value to Business. 658.3115
Roy Dickinson. *Printers' Ink*, May 21, 1925, pp. 3-4, 5, 148, 151, 152, 154, 157, 158, 160, 163, 164, 166. Thirty-three industrial concerns tell how they get college men and what they think of them.

Power Generation and Transmission

Fuel

The Application of Pulverized Fuel to the Industrial Plant. 621.18
Power, May 19, 1925, pp. 784-787. An outline of the basic considerations surrounding the burning of pulverized fuel, together with correct procedure in studying the installation proposal.

Economy of Fuel in Small Generating Stations. 658.26
The Power Engineer, May 1925, pp. 171-172. Analysis of operating conditions in a typical small power plant.

Factors Governing the Storage of Coal. 621.18
Power Plant Engineering, May 15, 1925, pp. 523-525. Benefits to be derived from coal storage and suggestions for storage methods.

Power Equipment

American Can Company Power Plant at Cincinnati, Ohio. 658.26
Cris Mottern. *National Engineer*, May 1925. Illus. Equipment and operating costs.

Extending Life of Furnace Wall by Water Cooling. 621.18
H. D. Savage. *Iron Trade Review*, May 28, 1925, p. 1424. Illus. Fins on boiler tubes protect walls and reduce maintenance.

Getting Double Duty from Firebrick. 621.18
H. M. Thompson. *Iron Trade Review*, May 28, 1925, p. 1380. Illus. Crushed firebrick is used as ganister for furnace maintenance, and to make furnace tiles, at the Sellers Mfg. Co.

Making Your Furnace Suit Your Fuel. 621.18
Francis Juraschek. *Industrial Management*, May 1925, pp. 284-290. Illus. Details of combustion furnace construction, and proper air supply.

Power-Plant Instruments. 621.18
R. S. Reed. *Power*, May 19, 1925, pp. 769-774. Illus. Description of various instruments used in power plants, indicating the uses of individual boiler panel, master boiler room panel, condenser gage board, and boiler-feed gage board.

Varnish and Gum Making. 621.18
A. Morgan. *Industrial Gas*, May 1925, p. 10. Comparative cost data for gas burning equipment.

Power Plant Operation

Diesel Engine Overall Economy. 621.4
C. B. Jahnke. *Power Plant Engineering*, May 15, 1925, pp. 535-540. Charts. First cost, operating cost, unit cost, reliability, and relative cost for pumping.

How Power Factor Was Improved by Using Rotary Converter as Synchronous Condenser. 658.26
Robert W. Drake. *Industrial Engineer*, June 1925, pp. 262-264, 305. Illus. Graphs show amount of corrective current obtained by this and an alternative method at the McCormick Works of the International Harvester Company.

Increasing Power to Meet Demands. 658.261
F. H. Moyer, MANAGEMENT AND ADMINISTRATION, July 1925, pp. 41-43. Illus. New boiler plant of the United Alloy Steel Company enables turbo-generators to run at capacity, and provides for future use of blast furnace gas as fuel, as is now done in original boiler house.

The Need for a Real Power Policy. 658.26
Douglas Henderson. *Industrial Management*, May 1925, pp. 266-268. A knowledge of present and future requirements in steam generation enables expansion to be intelligently planned.

Public Utility's Plant Very Modern. 658.281
Black Diamond, May 2, 1925, pp. 516, 518. Illus. Description of coal and ash handling and storage methods at the Philadelphia Suburban Gas and Electric Company's plant, where 50,000 tons of buckwheat coal are consumed yearly.

Power Transmission

How Service Conditions Affect Belt Capacity. 658.2621
R. F. Jones. *Industrial Engineer*, June 1925, pp. 265-270, 305-306. Illus. Tables and charts from tests show power transmitted and enable correct allowances to be made in laying out a drive.

Standardization of Transmission. 658.516
T. C. Keeling. *Cement, Mill and Quarry*, May 20, 1925, pp. 31-32. Shafting, hangers, pulleys, gears, and the terminology in this field should be standardized.

Marketing and Distribution

Advertising

Guaranteeing Purchasers a Standard of Quality. 659.1
W. Irwin Haskett. *Canadian Machinery*, May 14, 1925, pp. 13-14. Illus. Value of trade-marks made known to the public through advertising.

Industrial Art Means Industrial Efficiency. 658
Don Gridley. *Printers' Ink Monthly*, May 1925, pp. 33-35. Illus. Consideration of artistic values of products is of real value to manufacturers.

The Maintenance of Quality Compelled by Advertising. 659.1
Ralph Crothers. *Printers' Ink*, May 28, 1925, pp. 100-102, 104. Advertising helps the Fleischmann Company to hold down price and keep up quality.

Sound Sales Counsel Must Supplement Our Marketing Plans. 658.82
Arthur W. Sullivan. *Advertising and Selling Fortnightly*, May 20, 1925, pp. 17, 75-76. How advertising helps to break down sales resistance.

Waste Reduced by Advertising. 658.5671
Herbert Hoover. *Iron Trade Review*, May 14, 1925, pp. 1252-1253. Shortens and simplifies route between seller and buyer.

Selling

Capitalizing Past Prestige to Open New Markets. 658.8
Franklin Murphy. *Printers' Ink Monthly*, June 1925, pp. 39-40, 116. Methods used by Murphy Varnish Co.

Distribution a Governing Influence on Production. 658.8
G. Douglas Mercer. Bulletin of the Taylor Society, April 1925, pp. 111-115. A presentation of the responsibility of the sales department to sell the product of the factory in order that a suitable operating organization may be maintained and equipment utilized with a maximum of efficiency.

Establishing Sales Quotas. 658.808
Metropolitan Life Insurance Company. Leaflet. 11 pp. Charts. Describes the methods used by Burroughs Adding Machine Company in establishing sales quotas.

Getting Lay Dealers to Absorb Technical Facts. 658.82
E. B. Weiss. *Printers' Ink*, May 28, 1925, pp. 41-42, 44, 48. Method used by Haskins Manufacturing Company.

How Manufacturers Are Financing Retail Installment Sales. 658.883
Roland Cole. *Printers' Ink*, May 14, 1925, pp. 3-4, 6, 8, 181-182, 184, 187-188. Easy payment plans for buying various commodities are being advertised nationally. Dangers and benefits of installment selling.

How We Built Up Our Overseas Trade. 658.85:382
F. W. Copeland. *Advertising and Selling Fortnightly*, June 3, 1925, pp. 19-20, 36, 51-52. From experience of Sullivan Machinery Co.

The Interdependence of Production Engineering and Merchandising. 658.8
Ralph E. Rindfusz. Bulletin of the Taylor Society. April 1925, pp. 116-118. A plea for the application of scientific principles in marketing in order that manufacturing department may be supplied with a volume of orders to allow it to operate effectively.

The Outlook for U. S. Exporters. 382
Julius Klein. *Michigan Manufacturer and Financial Record*, May 16, 1925, p. 6. Vast markets for quality goods exist in foreign lands.

A Sales Manager Analyzes the Sales Manager's Job. 658.811
Martin J. Wolf. *Printers' Ink*, May 14, 1925, pp. 117-120. An inventory of what a sales manager must be and do.

We Made a Success Out of a Business Failure. 658.8
P. H. Noland. *Advertising and Selling*, June 3, 1925, pp. 15-16, 44, 46. Marketing methods used by Moline Implement Company.

What Can Be Done About Trade Abuses? 658.8
Herbert M. Maxwell. *System*, June 1925, pp. 734-737, 782, 784, 786, 788. Illus. Getting rid of the returned goods and discount evils.

Shipping

Better Shipping Containers. 658.788444
Floyd T. Smith. MANAGEMENT AND ADMINISTRATION, July 1925, pp. 23-24. Data on uses and advantages of all different types of containers.

Does Your Shipping Department Understand the Bill of Lading? 658.788
Richard C. Tarr. *Factory*, May 1925, pp. 777-778, 820, 822, 824. Resumé of the experience of many shippers in regard to bills for storage and customer ill-will due to failure to handle shipping documents properly.

Material Handling and Production Control

Material Control

An Economical System of Issuing and Checking Stores. 658.78
Russell B. Hobson. *Cassier's Industrial Management*, May 1925, pp. 294-295, 298. Charts.

New Worthington Tool-Crib Service Operates with Satisfaction. 658.563
Anker L. Christensen. MANAGEMENT AND ADMINISTRATION, July 1925, pp. 15-18. Illus. Methods of issuing and keeping track of tools have been brought to a high state of efficiency at low cost.

Union Pacific Centralizes Control of Stores Operation. 658.7
Railway Age, May 9, 1925, pp. 1146-1150. First of three articles on purchasing and stores organization whose operation cut stock $18,000,000.

Mechanical Handling

Claims Made for the Superiority of the Electric Shovel. 621.87
D. J. Shelton and D. Stoetzel. *Cement, Mill and Quarry*, May 20, 1925, pp. 15-17. Economical considerations; comparison of direct and alternating current drives.

Combined Gravity Bucket and Rope Conveyors, for Installations of Small Capacities. 658.281
Cassier's Industrial Management, May

1925, pp. 301-302. Illus. Application of mechanical handling for capacities as small as 3 cu. yd. per hr.

Huron Cement Co. Handles Bulk Cement in Large Volume. 658.281
J. M. Smallshaw. *Cement, Mill and Quarry,* May 20, 1925, pp. 19-20. Material handling equipment described, particularly a super-capacity bucket elevator.

Machine-Shop Transportation with Industrial Electric Trucks. 658.281
Harold J. Payne. *American Machinist,* May 21, 1925, pp. 803-804. Experience of the De La Vergne Machine Shops in using industrial electric trucks. Signal system controls their use, and each one is equipped with an ampere meter.

Material Handling in Upset Forge Plant. 658.281
D. L. Mathias. *Forging—Stamping—Heat Treating,* May 1925, pp. 146-152. Illus. Layout of plant, manufacturing methods and equipment, and material handling facilities of the American Forge Company's factory.

Modern Material Handling Methods in the Cement Industry—II. 658.281
C. H. Sonntag. *Pit and Quarry,* May 15, 1925, pp. 67-73. With special reference to kiln feeding in wet process mills, bagging, clinker and coal handling.

The Overhead Railways of Commerce. 658.281
Huntley Gray. *Business Organization and Management,* May 1925, pp. 97-100. Illus. Application and advantages of aerial transport systems.

Reduction Saving $48,000 in Materials Handling Costs. 658.281
F. C. Eibell. *Industrial Management,* May 1925, pp. 312-315. Illus. How an electric truck fleet, on regular schedule, serves a large metal working plant.

Selecting Material Handling Methods for Economical Production. 658.281
Graham L. Montgomery. *Chemical and Metallurgical Engineering,* April 1925, pp. 427-431. Illus. How the Dunlop Tire and Rubber Corp. developed a mechanical handling system that gives highly satisfactory results.

Skip Tubs Replace Ore Barrows. 658.281
John D. Knox. *Iron Trade Review,* May 7, 1925, pp. 1189-1193. Illus. Bourne-Fuller Co. stack, filled by hand methods for four decades, now charged mechanically, at a saving of 83 per cent of original crew.

The Storage Battery Locomotive. 658.281
J. G. Byrnes. *Coal Mine Management,* May 1925, pp. 44-45. This type of equipment eliminates fire hazard and is low in maintenance cost.

Westinghouse Shop Express System. 658.281
Stewart M. Lowry. MANAGEMENT AND ADMINISTRATION, July 1925, pp. 7-10. Illus. New system of small package delivery throughout the plant renders excellent service at moderate cost. Electric storage battery trucks are used.

Production Methods and Control

A Control Chart for the Chief Executive. 658.5
Wallace Clark. Bulletin of the Taylor Society, April 1925, pp. 105-110. Application of the Gantt chart to the work of the chief executive, showing that this may be used to visualize standards, record progress and achievements.

Practical Results of Time Study. 658.5421
S. Weese. *Werkstattstechnik,* March 15, 1925, pp. 193-196; April 1, 1925, pp. 233-235. Illus. (In German.) Rating of workers according to productivity and effort. Economic results of time study. Examples of savings produced.

Time Study with a New Allowance Curve in Connection with the Introduction of Management Methods. 658.5421
F. Wieber. *Werkstattstechnik,* April 1, 1925, pp. 229-232. Illus. (In German.)

Tolerances in Length Measurements. 658.562
P. Weber. *Werkstattstechnik,* March 15, 1925, pp. 203-205. Illus. (In German.) Basis for measurements, and development and application of a uniform method.

Employment and Personnel Management

Employment and Training

Co-ordinating Employee Training. 658.386
L. A. Hartley. *Iron Trade Review,* June 4, 1925, pp. 1451-1454. Illus. Shortage of workers can be prevented only by participation of government, employers, universities and other organizations in training plans.

Management Principles of Apprenticeship—III. 658.386
H. A. Frommelt. *Industrial Management,* May 1925, pp. 306-308. Education. Drawing up a schedule, planning methods of instruction and selecting instructors.

The Psychology of Selecting Men. 658.3115
Donald A. Laird. McGraw-Hill Book Co., New York. 274 pp. $3. A discussion of the fundamental psychological considerations in selecting employees. Includes descriptions of various psychological methods and means of finding the right person for particular jobs, and how these methods are applied in actual employment work. Contains many charts and examples from life to clarify and amplify the text. The book should be of considerable value to all who are engaged in personnel work or who are interested in the subject.

The Selection and Training of Salesmen. 658.807
H. G. Kenagy and C. S. Yoakum. McGraw-Hill Book Co., New York. 380 pp. $3.50. Discussion of scientific methods for developing a sales organization, based upon investigations made by the Bureau of Personnel Research of Carnegie Institute of Technology. These studies have resulted in a practical and usable body of standards, specifications, tests, and ratings, which are made available in this book. Because information contained is not theoretical but based on successful experience of selling organizations, this book should be of considerable value to all business men who are directly or indirectly connected with selling.

Training Course Develops Power Plant Personnel. 658.386
H. A. Frommelt. *Power Plant Engineering,* May 15, 1925, pp. 549-550. Apprentice training methods used by The Falk Corporation.

Wanted: More Shop Apprentices. 658.386
L. A. Hartley. *The Iron Age,* June 4, 1925, pp. 1647-1649. Why industry faces an immediate problem in scarcity of skilled workers and how it can be solved.

Personnel

How to Reduce Labor Turnover. 658.3126
Russell Byron Williams. *Western Machinery World,* May 1925, pp. 193-194.

Social Insurance Benefits. 658.32544
Alfred Manes. *International Labour Review,* May 1925, pp. 611-631. Comprehensive discussion of provisions based on German practice.

Works Council Movement in Germany. 658.31513
Boris Stern. U. S. Dept. of Labor. 114 pp. History and development of system which is compulsory, types of workers' representation, relation between works councils and trade unions and similar information is given.

Safety

Age Limits and Physical Examinations of Employees. 658.3115
Journal of Electricity, April 1, 1925, pp. 237-240. Results of investigations with recommendations by the Tacoma Foremen's Conference.

Field Practice. 658.284
National Fire Protection Association, Boston. Leaflet. 16 pp. Report of Committee of Association giving proposed standards for regulation of watchmen and outside plant fire protection.

Fire and Injury Hazards of Electrical Origin. 658.3823
John A. Hoeveler. *National Safety News*, June 1925, pp. 7-9. Illus. Causes of accidents and means of preventing them.

The Medical Profession and Health Insurance in Great Britain. 658.325
Alfred Cox. *International Labour Review*, May 1925, pp. 632-658. Organization and operation of the system.

Treatment of Burns. 658.3822
J. J. Wymer. *Electric Railway Journal*, April 11, 1925. Classification of burns and their causes and effects.

Accounting and Financial Control

Accounting and Cost Finding

Basic Accounting. 657
George E. Bennett. The Gregg Publishing Co., New York. 777 pp. $5. Written primarily as a textbook for the large number of students who wish something more than mere bookkeeping knowledge, but do not care for the advanced material usually found in books on accounting theory. The fundamental principles of accounting are taken up in order and developed in considerable detail. Their relationships to business operation are indicated, showing the cause and effect of each transaction from its start to its conclusion in the financial statement.

Cost Accounting for the Power Plant. 657.452
Charles Dick. *National Engineer*, May 1925, pp. 220-223. Charts. Outline of method particularly adapted to industrial plants.

A Cost System That Tells a Complete Story. 657.452
H. Lionel Williams. *Motor Transport*, May 19, 1925, pp. 18-19. Forms. System used by Schust Company to determine delivery costs accurately.

Getting Job Costs Without Guesswork. 657.452
Walter N. Polakov. *Industrial Management*, May 1925, pp. 269-272. Illus. Collecting and calculating costs for accurate price quotations, with forms and charts used.

How Can Cost Work Be Simplified Without Impairing Accuracy. 657.452
F. H. Corregan. National Association of Cost Accountants, Official Publications. June 1, 1925, pp. 3-9. Suggests methods for the simplification of cost accounting work without impairing the accuracy of the results. In general, the suggestions are based on the use of representative types of product, material and labor, rather than securing detailed information in regard to all kinds, sizes and variations.

Methods of Ascertaining Daily Wage Costs. 657.452
O. Zirkel. *Werkstattstechnik*, April 1, 1925, pp. 240-242. Illus. (In German.)

Financial Control

Depreciation. 657.42
W. T. Bowker. *The American Appraisal News*, May 1925, pp. 117-128. A review of what depreciation consists of and how it may be evaluated.

How to Read a Financial Statement. 657.4
Herbert G. Stockwell. Ronald Press Co., New York. 443 pp. $4.50. Illus. A book which purposes to show the business man, in as non-technical manner as possible, how to ascertain the financial condition of a business from study of its financial statement. The first 13 chapters of the book treat with the comparatively simple statements of the typical average-sized concern. The remainder of the book deals with the more unusual features usually found in financial statements of large corporations. Numerous illustrations are used to clarify the text. The whole volume should prove to be of value to all business men.

The Present State of the Art of Office Management. 651
W. H. Leffingwell. Bulletin of the Taylor Society, April 1925, pp. 96-104. Report of systematic analysis and rating of a variety of offices during the last two years.

Shop and Office Forms. 651.5
Wallace Clark. McGraw-Hill Book Co., New York. 139 pp. $2.50. A discussion of the function of forms, their proper design and their economical use. First part of the book deals with design. Then is presented the relation of forms to the management of shop and office departments. The third part discusses general administrative features connected with forms.

New Industrial Equipment

Portable Furnace. 651.76
A forge consisting of an oil-burning torch and a retort mounted on a frame with wheels, can be used for melting lead or babbitt, melting cyanide for case hardening, boiling water and similar purposes. Made by Chausse Oil Burner Co.

Engine Driven Welder. 621.76
For use where electricity is unavailable. Standard WD-12 welding generator driven by Buda 22½ hp. engine, all mounted on skids. Made by General Electric Co.

Portable Acetylene Generator. 621.76
For producing acetylene at low pressure for welding and cutting. Has new type feed control and takes 35 lb. of carbide. Manufactured by Oxweld Acetylene Co.

Portable AC or DC Instruments. 621.3
Indicating instruments, including ammeter, voltmeter, single phase wattmeter, are compact, light, self-contained, show no appreciable errors in readings on direct or alternating current up to 133 cycles. Made by Westinghouse Electric and Manufacturing Co.

Electric Lift Tructor. 621.86
Handles platforms in yards and factory. Lifts 6½ in. from low position 17 in. above floor. Exide or Edison storage batteries furnish power. Made by the Elwell-Parker Electric Co.

Starting Switch. 621.3
For starting squirrel cage induction motors directly across the line. Push-button control. Overload and phase failure protection. Product of The Electric Controller and Manufacturing Co.

Twist Drill Grinder. 621.92
Portable electric for edge tools and drills. Tool holder assures uniform results. Manufactured by Keystone Grinder and Manufacturing Co.

Telescoping Crane Boom. 621.87
Can be adjusted to four lengths between 12 and 17 ft. and is improvement to Elwell-Parker Type CK portable electric crane. Permits heavier lifts and operation in low head room.

Rivet Set. 621.97
The jack set is a forged, heat-treated, alloy steel rivet set for use in pneumatic hammers manufactured by Ingersoll-Rand Co.

Safety Switch. 621.3
For general industrial service, embodies a number of features to make its operation safe. Manufactured by Westinghouse Electric and Manufacturing Co.

Hoist Attachment for Fordsons. 621.86
Portable equipment for lifting and carrying. Securely fastened to Fordson which furnishes power. Manufactured by Clyde Iron Works.

49-61

MANAGEMENT
AND ADMINISTRATION IN
MANUFACTURING INDUSTRIES

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Real Safety Movement to Come

Executives Must Make It a Major Responsibility

CAN safety be made an executive responsibility? This question is of more importance than may be apparent, for upon its answer hinges the future of the safety movement in American industry.

The present situation is remarkable, the outstanding features which characterize it being as follows:

1. Sustained general interest in industrial safety, accompanied by a lack of executive interest.
2. A pause in the reduction of industrial accidents, though the aggregate number in American industry is still enormous.
3. Steadily increasing costs of safety work.
4. Persistent unfavorable workmen's compensation loss ratios.

There are indications that a new development is coming in the safety movement in American industry. The change will be to a more fundamental stage where safety will be an interest and responsibility of the highest executives. This means more than securing the co-operation of manager and superintendent. It involves putting executive thought and energy into safety plans and programs as well as into production, elimination of waste, cost reduction or other major activity.

The end of this situation will mark the close of the first or superficial stage of the safety movement and will usher in the second or more fundamental stage. It will also mark a shift of responsibility for the industrial safety program from the "safety man" to the management, for this desirable second stage and its progress cannot come until the interest and active participation of executives is secured. This solution of the problem presented is therefore proof that safety is an executive responsibility.

Lack of uniformity of opinion on the part of prominent leaders in the safety movement is shown by answers in the November 1923 issue of the *National Safety News* to the question: What is the most important factor in safety work? Walter Teagle, president of the Standard Oil Company of New Jersey, thought "the trained leader." The Ford Motor Company believed that "complete guarding and redesigning of unsafe equipment" was most important. H. F. Perkins, vice-president of the International Harvester Company, declared for "co-operation of employees, intelligent supervision, and cordial support of the management." A. T. Morey, general manager of the Commonwealth Steel Company, found "sincere interest and backing of the management" to be essential, while S. F. Shattuck of Kimberley-Clark Company thought genuine interest of the foreman the most essential factor for safety work.

Mr. Morey undoubtedly hit close to the imperative need of today when he asked for "sincere interest and backing of the management." The safety movement must be made a part of the fiber and tissue of continuous management interest and responsibility. It must go forward in company with other great management movements, such as increased efficiency and elimination of waste. When this is done, the real safety movement will be born. In this form it will become a part of a thorough-going industrial effectiveness or efficiency, both human and mechanical. Such an efficiency will yield a high operating morale in the working force, resulting in:

1. High production.
2. High degree of safety.

Once these possibilities are appreciated by industrial executives there will be aroused that interest in the safety movement which is so essential for progress, but which at the present time seems lacking.

But few records are available tending to show on the one hand that a safe factory has a high production record, and on the other that the factory with a mediocre or poor safety record has a low production record. However, many managers and industrial leaders believe that this relationship holds and that it is only necessary to secure the production and safety records from a representative group of industrial establishments to be able to present complete proof. It is sincerely to be hoped that some such investigation will be made, thereby establishing once and for all the correlation between safety and production. Once this is done, a long step will have been taken in bringing the safety movement into the great field of executive interest and responsibility.

Such a study would have value for another purpose. It would put in sharp contrast the high level of safety attainment and records in those plants which have the best managed safety programs, with the much lower but average level of a major branch of industry or of industry as a whole. It can be safely predicted that there is a wide stretch between these two records indicating the zone in which immediate improvement can be made.

This comparison would be a spur to the less effective plants by showing the improvement and savings possible to be made to meet a standard already attained, not one established on theoretical grounds. Furthermore, quantitative facts are always triumphant over opinions and rhetoric, and such a comparison would be a presentation of actual, measured results.

To show the relationship between safety and production Sydney Williams is credited with this illuminating bit of reasoning. If a loaded truck is passing through an aisle of a factory and a heavy casting falls off, crushing the foot of a workman, an industrial accident has occurred. The occasion is the dropping of the casting due to improper loading, and the fact that this particular casting fell off is known because of the human injury. However, there is no record of the other times in which similar castings have fallen from trucks due to improper loading, where no one was hurt. But each occurrence of this kind required the truck to pause and necessitated an expenditure of time and human energy to reload the casting in order that it might reach its destination. That is, the industrial accident was the indication, first, of improper loading and material handling and, second, of inefficient management and waste.

A Bit of Experience

In outlining the possible steps to bring into being a real safety movement, a sharp analogy can be drawn with another movement whose progress and development has been so prominent within the last eight years.

The personnel or employment management movement had a rise exhibiting many of the characteristics of the safety movement. In its beginning it became an addition to the management organization and plan, in many cases having an almost independent existence, influencing operation and production through the channel of its own interest rather than along the main executive path. This situation persisted more or less generally until the business slump of 1921-2 when so many personnel departments and organizations disappeared, although the personnel function persisted. As business conditions changed and personnel work entered its second period of expansion, it became closely knitted into the executive fabric, where it is today, in its best and most highly developed form.

So desirable was this change that about 1921 there came an insistent demand from many industrial leaders to make personnel work a management interest and function. The result has been an increased respect for personnel and employment work, with measurable results of the highest value and an assured place for the personnel function in every well-operated manufacturing establishment.

The same process of development is open to the safety movement, which has numerous unfortunate situations, if not absolute evils, to eliminate. Make safety work an executive interest and responsibility!

Co-ordinating Maintenance Work

Once executive interest is directed toward the safety movement it may be expected to include other activities which are now spread between several executives in the usual manufacturing organization, or even take up others whose value is but beginning to be recognized. Prominent among the latter is the mental hygiene of industrial workers. It is becoming recognized that there are certain persons, possibly more in proportion than is suspected, who find it difficult to adjust themselves to industrial life. They comprise a part of the "floaters" who are continually changing jobs with no good reason, probably many of those who have difficulty in "getting on" with their fellow employees and their foreman, and others who are looked upon as having character defects that unfit them for success in industrial pursuits. Investigation may show that the persons afflicted with this difficulty of adjustment form an appreciable proportion of those who suffer from industrial accidents attributable to their own carelessness or negligence.

A few investigations have been made into the lives and possibilities of adjustment of some of these misfits with encouraging indications. Therefore it may well be that an enlarged safety program will include mental hygiene.

Other activities which are too often imperfectly co-ordinated in addition to safeguarding machines, safeguarding work places and safety education are: medical supervision, plant hygiene, plant sanitation and plant maintenance. Taken together these form a great group of maintenance activities which hold within their conduct the possibility of major savings and great reductions in waste, once they are properly organized, co-ordinated, and subject to continual executive supervision and control.

None of these comments should be construed as a reflection upon the safety work already done. Its rise and development is one of the outstanding records of American industry. But the path of future progress is to make safety an executive responsibility.

28 Cases Where Good Lighting Paid

Correct Windows, Glass, Paint, Blinds and Lamps Aid Manufacturing

By RUSSELL J. WALDO

AN analysis of natural and artificial illumination in nearly 300 American factories, recently conducted by the author, has brought out the factors of well-defined lighting practice in the modern manufacturing plant. Typical cases are presented in this article based on information which the various executives have given permission to publish.

An Illinois manufacturing plant, making light cast-iron products, has a building 112 by 362 ft., and 25 ft. high at the side walls. The building is of single story construction, and the windows extend practically from the eaves to within 18 in. of the floor. Monitors 16 ft. wide, and built with double sides, are installed in the roof. They permit the light to come in from two directions. The area of windows is approximately 27,652 sq. ft. for the side walls and 11,584 sq. ft. for the monitors, making the total 39,236 sq. ft.

There are no outside obstructions within 30 ft. except at the north end, where another building is 15 ft. away. The wall of this building is painted white to act as a reflecting surface. The ceiling and upper part of the room interior are painted gray, and wire glass is used in the windows. As the glass is pebbled in effect, it more evenly diffuses the light and eliminates glare.

There are approximately 200 workers in the building, engaged in final finishing and assembling operations. They were brought into this new building from an old-fashioned type of three-story structure, and it was possible to obtain a fairly accurate estimate of the increase in production which resulted from better lighting conditions. The same number of men in the new building now produce approximately 5 per cent more product and the rejects have been reduced fully 6 per cent. This improvement was evident at the end of the first three weeks after the workers had become accustomed to the new environment and lighting.

The top floor of a two-story tool plant in southern Ohio was formerly lighted from above by a narrow monitor with small windows. A few years ago the roof was remodeled by adding a high monitor with double sides. Clear glass was used upon the north side and pebbled glass upon the south side of the monitor. The side walls still have their original small sash, yet the addition of the approximately 3732 sq. ft. of overhead window area has brought about an increase in production of nearly 6 per cent from the workers in the center of the room. The new design directly affects about 100 workers. The effect upon the workers near the outside of the room has not been noticeable. The first floor of this building was not included in the study.

The furnace building of the Edison Lamp Works of the General Electric Company at Harrison, New Jersey, a building 135 ft. wide, has one of the most effective designs of monitors that the writer has ever seen. In the center of the building are the furnaces which discharge a huge volume of smoke. This is drawn directly to the monitors above and passes out as rapidly as it is formed. The monitor has an area of about 9600 sq. ft. The side wall windows extend close up under the eaves and are at average height from the floor. The air entering the room near the

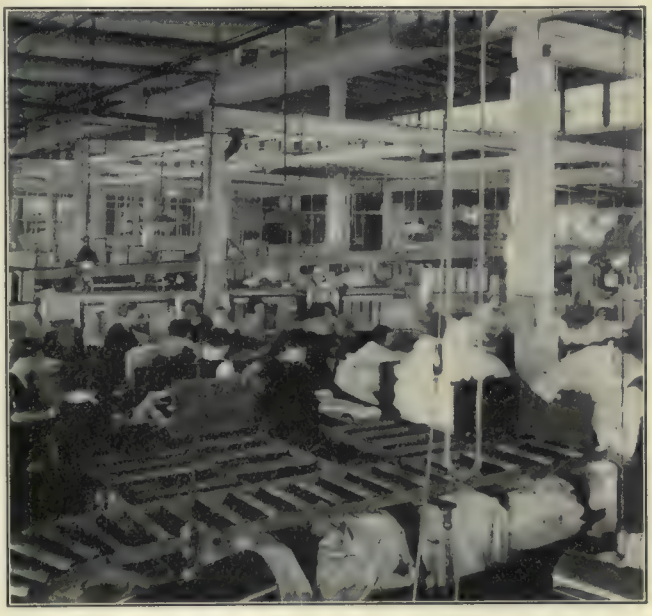

FIG. 1 DAYLIGHT SCENE IN REAL SILK HOSIERY MILLS

floor forms the draught which pulls smoke from the building. Unfortunately, comparative production figures are lacking.

The body and radiator building of the Ford Motor Company, Detroit, Michigan, is 800 ft. long and has a monitor with two slopes down from the center, each side being about 23 ft. wide. In the assembly plant at Kearny, New Jersey, the company has utilized fully 95 per cent of the wall area for glass. This practice applies to every assembly plant recently erected by the Ford Motor Company.

One need only to enter the large assembly building

of the Studebaker Corporation at South Bend, Indiana, in which approximately 82,214 sq. ft. of the wall area is of glass, to understand the real reason why they can maintain large-scale production with so little rejected material. When they moved into the new plant, a large additional force was taken on, which makes comparative figures of little value. The side wall windows are of pebbled glass, and extend from the ceiling to within approximately 18 in. of the floor. A monitor extends the full length of the court. It has frosted glass sides and roof, except upon the north side where clear glass is used. The court sides are painted white, and no chance to reflect light is lost.

Use of White Paint in Lighting

Another important factor to be considered in lighting is the reflecting value of walls and ceilings within the work shop, and the walls of surrounding courts and nearby buildings. Dark walls reflect no light. The modern tendency is to paint all surfaces white, with paint that can be washed and kept clean. White paint provides an excellent reflecting surface and is most effective in increasing production within the shop. Fig. 1 shows a combination of a white interior with ample window area and a good monitor.

One of the large packing companies in the east, primarily for sanitary reasons, painted its machines, walls and every suitable object white, with enamel finish on the concrete. After the work was accomplished it was found that beneficial results had been obtained also from the standpoint of lighting. Lights were turned off 30 min. earlier in the morning during the winter months, and were turned on at least 30 min. later in the afternoon, thus saving one hour's lighting expense each day. Natural light was well diffused and better to work by because it caused no shadows such as the machines cast when electric lights were on. One of the officials of the company told the writer that, although no comparative records had been kept, the gain in production was well worth the expense.

One food packer states that, after painting his plant interior white, he increased the volume of light still another 10 per cent by painting the courts white. In his opinion, this step is as important as painting the inside of the plant white.

A manufacturer of small machines informs the author that by painting the courts of his plant in white he increased the production of the workmen at benches along the windows at least 8 per cent, within five days after painting.

One knitting mill owner claims that since painting the walls of his factory white, production has increased at least 4 per cent, lighting current consumption has decreased 25 per cent, and accidents have dropped to nearly nothing.

Another knitting mill manager informs the writer that he has reduced his lighting current 16 per cent. His plant, because of the quality of work, requires the best of light, but by means of white paint he has reduced the amount of artificial illumination necessary.

Certain outstanding features make white paint an important factor in providing for adequate lighting.

It eliminates dark corners within the plant.

The painted surface acts as a reflector, reducing the electric current consumed for artificial lighting.

FIG. 2 VENETIAN BLINDS IN COHN, GOLDWATER SHIRT FACTORY

If enamel is used, simply washing with soap and water restores the surface.

It encourages cleanliness.

Window shades in the past have gained little attention. However, many engineers now realize that means of regulating daylight along the south side of workrooms deserve the most careful study.

One shirt maker informs the writer that by using Venetian blinds on his windows he has increased his production at least 14 per cent. This saving is made possible through elimination of the glare within the plant.

Blinds composed of single strips placed vertically

FIG. 3 DAYLIGHT SCENE IN WESTINGHOUSE LAMP WORKS

one above the other reduce the amount of light admitted as much as 18 per cent, as compared with the amount of light let into the room with the Venetian blind. The latter, because of the fact that the slats

may be adjusted to reflect the light up to the ceiling, is the most desirable shade for admitting the maximum of light without glare, and for allowing free circulation of air. Formerly such blinds were installed only in the office, and largely because of appearance. Now, however, they are recognized as economical for use throughout the entire plant. (See Fig. 2.)

Artificial Illumination

One of the large watch factories is partially dependent on artificial illumination. Formerly, 50 watt units were used, one for every 15 sq. ft., and at a height of 6 ft. from the floor. These have been replaced by 100 watt units with frosted tips in the same fixtures, and 7 ft. from the floor. The ceilings and walls were painted a light cream color. Production figures for this plant show an increase of about 11 per cent since the change. This is a remarkable showing from so small an outlay.

In the assembly department of a typewriter plant the lights formerly were directly at the work benches. These lights were changed from 50 watt to 100 watt units, raised to 7 ft. from the floor, and equipped with reflectors. The spacing was unchanged—one light for

FIG. 4 NIGHT SCENE IN SAME DEPARTMENT, WESTINGHOUSE LAMP WORKS

every 16 sq. ft. of floor area. The result was an increase in assembly output of 11 per cent.

Figs. 3 and 4, views taken in the same room, show a comparison of daylight and good artificial illumination in the Newark plant of the Westinghouse Electric and Manufacturing Company.

In the production department of an automobile plant, where the ceiling had become blackened with smoke and general lighting was used, rejected work amounted to 14 per cent of the production. The ceiling was thoroughly cleaned and painted white. The light units were left 7 ft. from the floor, but instead of one 60 watt unit, two 40 watt globes were used in indirect lighting units. One unit in this case serves approximately 16 sq. ft. Production has increased 17 per cent and the rejects dropped to about 6 per cent.

In the automatic screw machine department of another machine shop where formerly 50 watt bulbs had been used in indirect lighting units 7 ft. above the floor, with small reflectors, a remarkable result was produced. The lights were raised to 9 ft. from the floor, and 100 watt globes with large reflectors were installed, one unit for every 20 sq. ft.

Formerly at each machine there was a local 40 watt drop light. Now an Anderson bowl reflector is used with adjustable arm and a 25 watt bulb. The light (of the type shown in Fig. 5) is used only as necessity requires. This change has resulted in an increase in production of 16 per cent and a decrease in rejects of 11 per cent. The setting time has been reduced 7 per cent.

A foundry was formerly located in a building where the lights were 6 ft. from the floor and one 50 watt lamp served every 35 sq. ft. of floor area.

The present building has a main aisle in which there is a crane runway 26 ft. high, with the lamps suspended 18 in. beneath it. Each bay in this aisle is 1050 sq. ft. in area, and is lighted by two direct type units, each equipped with a 300 watt lamp. The units are 25 ft. apart. In the side aisles the bays are 20 ft. by 40 ft. and each is lighted by two units, each unit equipped with a 200 watt lamp. The lamps are about 11 ft. from the floor.

In this new building the same number of men are accomplishing a trifle under 14 per cent more work than previously in the old building.

In one drafting room, where formerly there had been 50 watt general lighting units and an individual 40 watt light upon every table, the lighting was changed to 75 watt indirect units. Each unit was placed where the former 50 watt general lighting units had been located. The room measured 20 by 40 ft. and one unit was installed for every 44 sq. ft. of floor area.

With the change, the ceiling was painted white. The former total wattage of 1540 was reduced to 1350. This amount of lighting seems inadequate for a drawing room. However, close questioning of all men in the room brought out the fact that the light was more satisfactory, caused less strain on the eyes, enabled them to assume a straighter posture at their work, and left them less fatigued in the evening. According to the chief draftsman, the output of the room is at least 10 per cent greater than before.

Another drafting room formerly was in a poorly lighted building where 60 watt lamps were provided in the general units and 40 watt lamps for individual tables. The ceilings were 8 ft. high and each unit served 30 sq. ft.

The department was moved into a new room 10 ft. high and having 1600 sq. ft. area. There are 15 lighting fixtures of the indirect type in the room, each equipped with two 200 watt lamps. The present fixtures hang about 3 ft. from the ceiling and are spaced about 10 ft. apart. The change, while not measurable in production figures, has brought about more rapid work, due to the draftsmen feeling better and less tired, and has also resulted in decreasing errors.

Upon questioning 65 girls at quitting time last December in a glove factory, the writer found that

38 had headaches because of the poor lighting. The lights were 7 ft. from the floor and spaced to serve approximately 19 sq. ft. Two days later the light bulbs were changed from 40 watt to 60 watt units. No other alteration was made. Three days after the change had been completed 63 of the same girls, including every one of the 38 formerly experiencing headaches, had no ill feeling whatever. The same day their production

FIG. 5 ADJUSTABLE REFLECTOR WITH HANDY SWITCH

had been increased 12½ per cent over the amount under former lighting conditions.

In one of the textile mills, where no attempt had been made to separate work by colors, localized lighting was used, with 20 watt globes at the work and 40 watt general lighting globes 8 ft. from the floor. The lights along one side were changed to 100 watt globes with glass reflectors. Then all dark colors were taken to that side. The other side used the same equipment with 60 watt globes. Here the lighter colors were worked upon. This change has increased production at least 19 per cent and reduced lay-off of workers 2 per cent. Formerly the girls were always subject to headaches. Now there is seldom a complaint.

In a shirt factory local lighting was formerly used in connection with general lighting. The local lights were 40 watt bulbs and the general units were 60 watts. The latter were 10 ft. above the floor, and the local units were drop lights close to the work.

The general lights were lowered to 7 ft., larger reflectors used, and the bulb changed to 100 watts. The drop lights were removed from the individual machines and the new lighting units were located to serve 16 sq. ft. of floor space each. The machines were rearranged, bringing the work end nearer the light units. The rearrangement brought out an increase in production of 12 per cent, accidents were reduced in numbers 4 per cent, and the material being sent back for reworking was reduced 9 per cent.

One clothing manufacturer increased production 11 per cent merely by replacing all old-fashioned arc lights with modern Mazda lamps of 100 watts each, using only one light for every 20 sq. ft. The arc light wires were used where they were. This was a simple yet most effective change.

Mercury lamps, as shown in Fig. 6, produce a most effective light. One automobile company using them in its new building increased production 18 per cent. One 100 watt unit is provided for every 30 sq. ft. of area, and the lamps hang about 7 ft. from the floor. These are ideal lamps for assembly operations.

By using a patented glass reflector (X Ray), which distributed light more effectively upon the work, one automobile company increased production 11 per cent with only one watt consumption per sq. ft. and lamps 7 ft. from the floor. The Kissel Motor Car Company at Hartford, Wisconsin, is using these reflectors with one 100 watt lamp to each unit, 9 ft. from the floor and 10 ft. apart. The building is as light as day, but because of the nature of the work it is impossible to secure comparative production figures.

The Seymour Woolen Mills, Seymour, Indiana, experienced great difficulty with illumination in the older buildings of the plant. The tying of broken ends and similar processes and inspections necessary to keep the product up to standard quality required lighting of the very best. The X-Ray type reflectors have been adopted with 60 watt lamps mounted 8 ft. high over the machines and 9½ ft. in the aisles. The illumination obtained is 5 ft. candles on the working plane. The company states that it has increased production fully 20 per cent through the use of these reflectors.

One personal experience may not be out of place. The author for years used what was believed to be one of the best desk lamps produced. However, tiring of eyes early in the evening finally caused him to adopt

FIG. 6 MERCURY LAMP ILLUMINATION IN SILK THROWING ROOM OF REAL SILK HOSIERY MILLS

the Emeralite desk lamp with daylight screen and a 50 watt bulb. The surface of the desk is painted a dull green. He has gained fully three hours every day through the use of this lamp and always carries it with him when he visits other cities.

Good light is one of the most important factors in manufacturing. The enormous waste through the use of former types of windows, glass, dull paint, heavy shades and poor lighting equipment can be prevented by a little study and a small investment. Besides protecting the eyesight of workers, adequate facilities will have a marked effect on increasing production.

System for Budgeting Co-ordinated Sales and Production

With Selling Prices Set a Budget Safeguards Your Profits

By EDWARD H. TINGLEY*

Delco-Light Company

WHICH makes the profits in your company—sales force or factory? If you will consider this question carefully you will find that in a great many instances the factory deserves the larger share of credit. Have you figured for your company the dollars of sales secured for each dollar spent by the sales department? Isn't it surprisingly low? Then remember that out of the few dollars of sales secured, the factory must buy the materials that enter into the product, must pay the labor to make the product and supply the overhead or burden items of heat, light, power, supplies, indirect labor, office force, depreciation, rent, etc. The profit secured is then the balance left after administration and sales expense are also deducted.

If the factory is making the profits, how does it do it? Is it done by skillful purchasing of supplies and raw materials; by a low labor market; by the selection and use of special and automatic machinery; by good organization to reduce supervision and overhead; by careful planning of the flow of materials through the departments; or by a proper stock of semi-finished parts in storerooms which can be readily assembled to meet the varied sales demand?

Factory Responsibility for Profits

What help are you, as manager, giving the factory organization to aid them in keeping up the flow of profits? Are you pushing sales to get increased volume for the factory when what it needs most is standardization on a few units? Has it been given a possible schedule of production to get tooled for and buy machinery for? Is it kept in touch with the policies of the business to knew what to expect in the future?

Today many concerns are operating in a price market where many competitors are struggling to secure the business and are using every legitimate means to under-bid the other fellow. This creates a sales resistance and therefore it costs more to secure sales. This again throws the burden of securing the desired amount of profit back on the factory. It is easily seen then that the factory operations should be fully understood by the manager and every assistance offered to co-ordinate production with sales properly.

Another phase of the same line of thought: Your selling prices are set—how do you safeguard your profits? What tangible plan is in use whereby your costs are kept steady, your sales and advertising expense proportioned to the production desired, and everything anticipated as far as possible? Does your present method of operating make you reasonably certain that with a quota of sales secured, the desired profit will be available at the end of the year?

Definite Plan of Action

The use of *budgetary control* is the answer to this and many other questions. It provides a definite plan of action; co-ordinates sales and production; regulates expenditures; presents a goal of achievement; forces policies to be definitely stated and makes the aim of all, both sales force and factory, *profits*.

The budget is nothing new; business has had it in various guises and methods for many years of the past. It was usually restricted to a part of the factory or of the business and never accomplished its full duty. The modern budget covers the entire business; every department and branch has a definite part in it. It puts the one aim of profits before all, and every act must conform to this yearly plan.

A budget is simply planning ahead, for one month, three months, six months or a year, the probable sales, the production, the expenditures allowed the various divisions of the business and the resultant profits to be secured. Budgetary control is the operation of all parts of the business so that expenditures do not exceed the budget allowances, production is up to schedule and the volume of sales is secured. If this is done, the desired profit ought to be obtained.

A very satisfactory budget period is a year for the general forecast. Many businesses are seasonal, have varied demands and probably several products which cause varied production problems and uncertain warehouse conditions. Nevertheless the management of any business should look ahead over a future period and set a goal of achievement and a plan to be worked out. The yearly forecast made in November or December for the following year causes every department and division of the business to analyze its operations, calculate relationships and justify expenditures in relation to results secured. It is known that this yearly total forecast is but a general calculation of the probable future status of the business, and that the details are to be worked out month by month.

Experience has demonstrated the value of forecast-

* Co-author with Thos. B. Fordham of "Organization and Budgetary Control in Manufacturing."

ing the purchase of productive materials, the direct labor, the overhead expenses, shipping containers, payroll, etc., by making a tabulation of the monthly production in units of each product. This is done for the entire year and is the basis for various calculations.

TABLE 1. ESTIMATED SALES DEMAND PER MONTH FOR JAN.–JUNE 1925

	Jan.	Feb.	Mar.	Apr.	May	June
Product A	100	150	250	350	500	700
Product B	60	60	70	70	80	80
Product C	1,600	2,400	3,100	3,500	5,000	4,800
Product D	500	400	500	550	600	800
Total	2,260	3,010	3,920	4,470	6,180	6,380

If the factory attempted to produce the products according to the sales demand it is readily seen (Table 1) that in May and June about three times the number of productive employees would be required. This would be poor management and very expensive also. So a new study is made to determine what is the best production schedule to be used (Table 2).

TABLE 2. ESTIMATED PRODUCTION RATE FOR JAN.–JUNE 1925

	Jan.	Feb.	Mar.	Apr.	May	June
Product A	250	250	300	350	450	450
Product B	70	70	70	70	70	70
Product C	3,000	3,000	3,500	3,500	3,700	3,800
Product D	500	400	500	550	600	800
Total	3,820	3,720	4,370	4,470	4,820	5,120

This creates a more satisfactory production schedule and provides steadier employment for a greater nummer of employees. The peak load can be taken care of by overtime, Saturday afternoon work and possibly a few more employees.

With this tabulation as a basis, many things can be calculated. A curve of direct labor is easily plotted for the entire production by evaluating the direct labor per unit of costs. The chart of Fig. 1 shows the comparison between direct labor of the sales demand and that of the revised production schedule.

In deciding to manufacture ahead for stock and filling up the warehouse with finished products, various items must be taken into account: Can the product be made and stored without deterioration? Has the factory sufficient warehouse space? Can the finished parts be made and stored rather than storing the complete assembly?

What will this advance production mean in increased inventory? Will the financial condition of the business permit of tying up so much cash for several months? Is the market demand stabilized so that stock on hand can be disposed of several months later? Is there any probability that changes in design of the product will be made which will make obsolete the parts in stock, before they can be assembled and sold?

From the material purchasing, storage and handling viewpoint, it may be necessary to smooth out the peak sales demand so that the present facilities will be adequate. It is more economical to use the present machinery and equipment a greater number of days than to purchase extra equipment and run it day and night for the peak period.

A balance must be struck of all these items and a tentative decision made to produce on a certain monthly basis for the budget year. A budget is drawn up and a study made of the cash required for pay-rolls, purchases, etc., and a monthly profit and loss statement prepared. From this the general manager knows what his problems are.

After the yearly forecast comes the monthly detailed analysis, covering the present month and the three

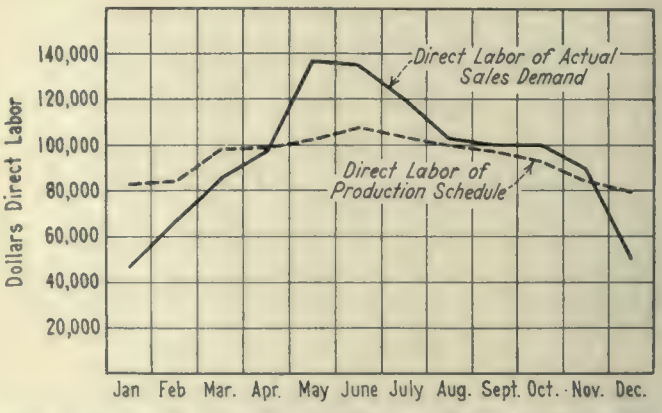

FIG. 1 COMPARISON BETWEEN SALES DEMAND, AS INDICATED BY DIRECT LABOR OF SUCH DEMAND, AND THE MORE ECONOMICAL PRODUCTION SCHEDULE

months following. For example, in November or December 1924, the estimated operations for 1925 are made up in a budget for the year. Then in the early part of December a budget is made up covering December, January, February and March. In the early part of January a budget is made up for January, February, March and April, and so on. Experience has proved that the four-months forecast is the most satisfactory, as market conditions change rapidly and four months are about as far ahead as it is feasible to forecast in detail. In some businesses, this is all that is necessary, as the time required to secure raw materials, fabricate

TABLE 3. BUDGET OF OPERATIONS FOR THE MANUFACTURING DIVISION

Controllable Expenses	June	July	Aug.	Sept.
Indirect Labor	$ 60,000	$ 61,000	$ 60,000	$ 60,500
Supplies	19,000	19,100	19,000	19,050
Power, Light and Heat	5,000	5,200	5,100	5,100
Maintenance Labor	1,500	1,600	1,200	1,200
Maintenance Materials	900	1,000	800	800
Scrap and Lost Time	1,200	1,400	1,400	1,400
Sundry	500	500	500	500
Total Expenses	$ 88,100	$ 89,800	$ 88,000	$ 88,050
Shipping Containers	3,500	3,600	3,600	3,600
Productive Material Purchases	250,000	260,000	265,000	280,000
Non-Productive Materials	8,000	9,000	9,000	9,000
Direct Labor	105,000	102,000	100,000	98,000

the piece parts and assemble the finished product is within the four-months limit. Other industries, like paper making, may have to cut the trees one to two years in advance of the time the wood will actually be made into paper. Such industries will have to forecast very carefully, years ahead. Table 3 is a sample budget of expenses, direct labor, materials to

be purchased, etc., for the manufacturing division for four months.

To describe better the method of using a budget and the results to be obtained, the following list of steps in controlling a business through a budget is given:

1. The general manager determines the percentage of profit which is desired for the coming year and which can reasonably be expected upon the capital invested in the business.

2. The comptroller analyzes the costs of the product, the market, the past expenses of doing business; sets a quota of the product which must be sold; allots the amounts of money which can be spent by the various divisions in selling and manufacturing that quota, the result of which will be the profit desired.

3. The comptroller gives to each division head the estimates he has devised to cover the activities of that division, in the general program. Then each division head breaks these down into the departmental needs and expenses when operating under the estimated schedule. Each department's expenses are carefully estimated and the total for that division should equal the allotment given by the comptroller.

4. If the division head believes that he cannot do his full share of the program and operate within the

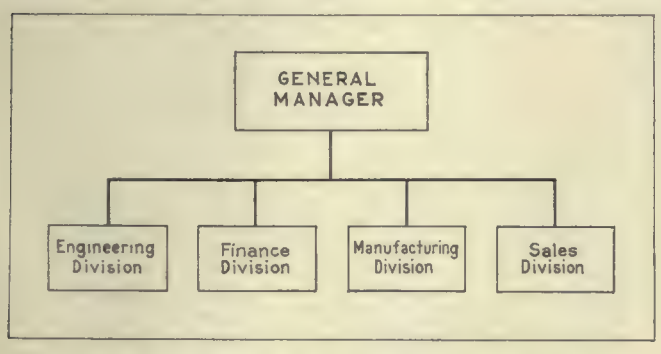

FIG. 2 ORGANIZATION FOR BUDGETARY CONTROL

amount allowed for expense in the estimates of the comptroller, he takes up the matter with the comptroller and arranges an adjustment.

5. When all divisional budgets have been adjusted and summarized, the final figures are given to the general manager, who approves them if satisfactory and authorizes the executives of each division to proceed accordingly.

6. Each division co-operates in its plans with the other divisions and schedules of production are made to coincide with the estimated sales demand. These production schedules are set about the 6th of each month to cover the activities of the following month.

7. Items of expense are closely watched and efforts made to operate each division so that the actual expense is kept within the allotted amounts.

8. The comptroller compiles a periodical (monthly or quarterly) profit and loss statement in which he sets forth the receipts from the sale of the product, the cost of the product, the expenditures made by the various divisions of the business and the resultant profit, if any. This is placed alongside the estimated budget figures in a form for ready comparison.

9. This report from the comptroller is sent to the general manager, who reviews it and asks an explanation where any items of estimated future expense exceed the allotted amount. He also takes action to increase sales where the estimated amounts are below that desired.

The first requisite of successful budgetary control is organization. The business should be divided into the four main groups of engineering, finance, manufacturing and sales, which in chart form will appear as shown in Fig. 2.

These four divisions should compass all possible parts of a business and any more are a useless burden and cost money in supervision and the time of the general manager to consult so many division heads to get action.

To carry this organization a step further to show what detail is necessary to secure definite and sure budgetary control in the operation of the factory, the manufacturing division is broken down into its five component parts—plant and grounds; machinery, tools and equipment; materials; labor and productive. A diagram showing how they appear is given in Fig. 3.

Such detail is necessary to provide reliable budget estimates of expenditures, production, material and labor requirements and building and equipment maintenance. As in the army, the best organization wins the battle.

After organization, the next important result to secure is to co-ordinate sales with production. The aim of every manager is to give immediate delivery to every customer and, at the same time, carry a very small inventory of parts in process and finished products in the warehouse.

A production schedule meeting held monthly has been found to be the best method of co-ordinating sales and production. This meeting is held about the 6th of each month, at which time the schedule of production for the following month is laid out. Representatives from the sales division and the manufacturing division and the comptroller comprise the committee and estimate the future sales and authorize the factory

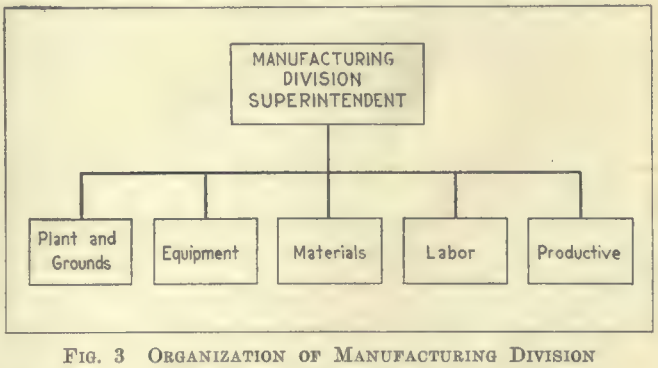

FIG. 3 ORGANIZATION OF MANUFACTURING DIVISION

to purchase materials, fabricate the piece parts and assemble the units of the product in time for the probable sales demand. This assumes that the factory is manufacturing for stock and not for special orders from a customer.

This monthly sales estimate as made by the sales division is checked against past performance by the

manufacturing division. Charts are kept of the production and sales of all the products. Fig. 4 shows the shipments of Product A for the past two years, and from this curve the probable shipments for any month of 1925 can be closely approximated, with allowances for the present business conditions and prospects.

Each product is fully charted for sales and production for years past and, being checked against the sales estimate monthly, a production schedule for a future month can thus be agreed upon, which will be found to be very close to what the actual conditions will be.

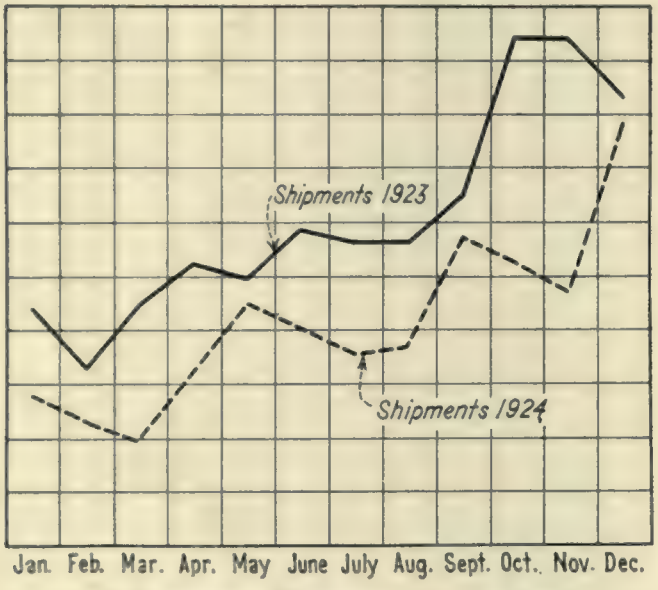

FIG. 4 SHIPMENT OF PRODUCT "A," 1923-1924

As previously described, additional production is included for stock so that the peak demand can be absorbed over several months in advance.

From the production schedule, the planning department will proceed to break the requirements, in completed units, down into sub-assemblies and piece parts, and order castings and materials at once, so that fabrication and assembly can be completed during the coming month, all according to the schedule set. The length of fabricating time also determines what amount of material must be carried in the storerooms to cover time to purchase raw materials, machine or tool breakdowns, scrap and defective workmanship, variety of products and sub-assemblies, etc. This means that the budget assembly schedule for the coming month is only a guide for the planning department to regulate the flow of materials through the factory departments so that the assembly schedules can be properly met.

A definite schedule of production will permit of very accurate estimating of purchases to be made, payrolls to be met, and overhead items of supplies, etc., to be known, for the budget month. These figures are used in compiling the estimated profit and loss statement and in figuring the probable inventory of parts and finished product which will be on hand at the end of the budget month. It is important that the total inventory does not increase over a satisfactory predetermined limit, for if it does it shows that either the sales are not as great as expected or the factory is over-producing.

As soon after the close of each month as is possible from an accounting standpoint, a report of actual operations is made. The actual profit and loss statement shows the general manager whether the business as a whole made the desired profit for that month. Detail figures of expenses, by departments, are given each division head and he can tell how each department met its quota or lived within its expenses. The actual figures are set up alongside the estimated budget allotment and the comparison is readily made. This permits also of selecting those items which have run high and a careful check is made on these expenses. This monthly comparison allows each foreman or department head to see what his department is doing and encourages him to strive to better his record. The facts of the business are made known.

The major results and benefits to be obtained from the operation of a business on a budget basis are as follows:

1. It assures planning ahead and projecting all operations in all divisions of the business on a basis that will assure a reasonable chance to secure the profit desired.
2. Centralized executive control is secured over the internal operations of the business.
3. It emphasizes the need of good organization and tends to demand its continuance as an assurance that the budget plans will be carried out.
4. Sales and production plans can be co-ordinated with financial resources.
5. The uneven sales demand can be kept out of the production schedules so that continuous operation at a predetermined rate will result in greater regularity of employment and in reduced costs.
6. Operating efficiency will be increased by the definite assignment of responsibility for expenditures, by the use of wage payments based on results, and by the maintenance of a steady flow of production in all departments.
7. Processes, equipment, and the product can be simplified and standardized.
8. The inventory of raw and finished materials can be kept at the minimum, thereby permitting increased rates of turnover of the money invested in materials, with the resultant increase in profits.
9. Costs can be used for the purpose of control rather than as historical information.
10. The possibility of any one division destroying the profits by unauthorized expenditures is prevented.
11. The financial division is better able to provide the necessary cash for the wages of the employees and the invoices for materials purchased.
12. More economic operation of the business is secured, as an opportunity is given to study expenses proposed before they are actually incurred.
13. Every part of the organization is given a definite goal for attainment.
14. The budget serves as a measuring stick to compare the standards and promises with the actual performance, showing not only what is possible but what must be done.

The Six Ways to Eliminate Waste

What They Are, How They Are Used, and What They Accomplish

By RAY M. HUDSON

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WASTE should be continually studied from the angles of eliminating the avoidable portion, and of reducing the unavoidable portion to the minimum. The method to be applied depends on the nature of the waste under consideration. In some cases one method will suffice; in others, another. In still other cases, a judicious combination of methods may be needed to yield the most satisfactory solution.

The methods commonly used in waste elimination are broadly classified as follows:

1. Direct reduction of wastes
2. Better utilization of by-products
3. Greater use of existing facilities
4. Revision of existing facilities
5. Simplification and standardization
6. Better control of production resources

Discussion of each of these methods and examples of their respective application follow.

Direct Reduction

The term "direct reduction" is applied to all efforts which have for their objective the curtailment of present losses or wastes without involving any additional expenditure of money.

The issue of more material than is required for a specific use or purpose is a form of waste which can usually be corrected by closer supervision. Similarly "soldiering," and other forms of labor waste, may be corrected with consequent saving. Shutting down machines, or turning off lights, when not in use, saves power, fuel, etc. These are homely examples, but by and large, they express the usual conception of waste. The elimination of such wastes calls for corrective measures which may range from common-sense frugality or thrift to absolute parsimony.

In factory work, one of the greatest sources of waste is spoiled work. It has long been recognized that one of the quickest ways to increase production is to cut down the spoilage. Usually a high percentage of spoiled work, or scrap, is cause for "jacking up" the foreman. While this form of corrective action may be applied in a way which defeats the end sought, more intensive supervision usually results in some appreciable reduction in the amount of work lost. Here the question arises as to whether or not the consequent retardation of production resulting from the worker's effort to be more careful increases the labor cost per piece out of proportion to the direct saving in material thus achieved. There are conditions under which a certain allowable spoilage may prove an economy. In such cases, such spoilages may be considered unavoidable wastes. Spoilage beyond the allowable maximum is obviously avoidable, and should be eliminated.

There are many ways of eliminating wastes by the direct reduction process. The best way in each case must be based on a study of the wastes, their nature, volume, and cause. Then with the facts in hand, the particular corrective measure can be determined on the basis of the cost of its application measured against the probable return from that application.

Better Utilization of By-Products

More and more industries are studying their waste heaps and seeking ways and means of utilizing materials formerly regarded as lost. Their efforts toward the better utilization of all these materials, these by-products, may be classified under three principal headings: (a) Salvaging; (b) reclamation; (c) by-product manufacturing. Each subdivision covers a specific line of endeavor, and is distinguishable from the other two by the differences in the methods followed in securing greater returns from waste materials.

Salvaging means picking up miscellaneous waste materials, sorting and classifying them prior to disposing of them to best advantage.

Reclamation is the process which follows salvaging, for, in determining disposal, it may be found worth while to recover, restore, or repair the salvaged article and thus render it fit to use again for the purpose for which it was originally intended.

As an example of salvaging, the present disposition of waste paper is typical. In many places it was formerly used for fuel, but as the methods of using waste paper in making new paper became better known, and the price of new paper rose, this waste material took on new value. Now it is carefully collected, baled and sold at a profitable price. One large metal-working plant ships nearly 500 tons of waste paper to the mills annually.

In reclamation work, the process is more complex. In some organizations, special departments or shops are organized to do nothing but reclamation work. These shops are equipped with a variety of machines suitable for the economical handling of a wide variety

of miscellaneous jobs, and the workers engaged are usually all-around men of wide experience and high mechanical ability. As an example, the plant previously mentioned repairs and makes new boxes of second-hand materials to the number of 60,000 per year and to the value of more than $30,000.

By-product manufacturing is the third phase. There are many examples of obtaining wealth from waste, particularly in the chemical processes of industry. The by-products of coke ovens are regarded as more valuable than the coke itself. In the steel industry, blast furnace gases are used for power generation, and one large plant is now contemplating the manufacture of automobile cylinder castings from the "dust" reclaimed from the furnaces.

The second stage in the waste elimination effort is the better utilization of by-products. It is chiefly distinguished from the primary stage—direct reduction—by the fact that better utilization invariably requires the spending of more money than direct reduction in order to recover the money already buried in the waste heap. Even in the elementary example of collecting and selling scrap metal, there are not only the expenses of those operations, but also the costs of handling, storing and transporting. These costs as of any particular date in relation to the market price then prevailing for the scrap materials determine the profitable disposition of the materials. Many transactions now occur in which costs are not fully considered, and so long as they are not constantly checked, the maximum return from the waste pile cannot be obtained.

Greater Use of Existing Facilities

In this third stage, we may include the usual examples of idle plant equipment which represent a heavy overhead charge. Idle cars, idle trucks, idle machines, idle men, idle materials or stocks, all represent unused capacity for production, the costs of which must be absorbed from the revenues derived from their active periods. All these facilities for doing productive work offer possibilities for profit or for loss in proportion to the extent of their use.

The greater interest evident these days in the industrial field in securing the maximum use of existing facilities is partly due to the influence of the war. During that period, many plants were greatly expanded to handle the huge war orders, but with the cessation of hostilities there arose the problem of what to do with the extra buildings and equipment. With the depression out of the way, and world conditions becoming more stable, this difficulty is vanishing, and though at present the potential plant capacity of our country is greater than the current consumption of our products, the facts show that the ratio of actual utilization to plant capacity is steadily increasing.

There is, in many fields, need for a constant survey showing the degree of use of all facilities capable of producing revenue or income, not only for the sake of determining the relative efficiency of operation, but also as an insurance against being caught unprepared to handle an increasing volume of business. Even with such information at hand, there is still to be considered the question whether or not it is advisable to expand present facilities, or employ a further method of waste elimination.

Revision of Existing Facilities

Perhaps there is no more striking example of waste elimination by revision of facilities than the application of conveyors in moving materials. Take the example of a factory where materials were trucked by hand from one machine to the next. The idea of the moving belt or platform arose out of the frequency of trips between machines, and the human labor required to maintain the volume of one-way traffic necessary to continuous production. What followed? Almost immediately the machines which were formerly departmentalized by class or kind were rearranged according to the proper sequence of operations required of them, conveyors were installed, and now the continuous movement of material by conveyors from receiving dock, through the shops, the assembly rooms, and onto the shipping platform and in some instances, even into the waiting cars, is common practice in every large-scale industry.

Throughout the entire range of revisions the problem of relative cost must be seriously studied and heeded. Admittedly, the calculation of such costs is more intricate than the calculation of the direct costs of current production; but that is no reason for passing them over lightly. The writer believes that the expense of determining the true costs of all revisions before they are made is a most reasonable premium on vital insurance against loss.

In such calculations, all the losses of scrapping the old design, material on hand, equipment or method, and the costs of new patterns, tools, etc., should be checked against the probable savings expected from the change, and only when the change is fully warranted by all the facts, should it be authorized. There is too much haphazard revision, and not enough precalculation of the cost, and as a consequence, the nation's scrap pile is many millions larger than it ought to be.

Simplification and Standardization

The object of production and distribution is to satisfy human wants. Goods are manufactured, transported and distributed because human beings have wants they seek to satisfy. The more people there are, the greater their wants, both in quantity and in variety. A greater number of different kinds of things must be produced to meet the growing demand. There are two methods of minimizing the waste caused by excessive variety: One is simplification; the other is standardization.

Simplification is that policy of business management which seeks to conduct all activities and to perform all functions of an enterprise, in the least elaborate manner consistent with any given purpose. It is the antithesis of variety and complexity; it means the elimination of the superfluous and the unnecessary.

Simplification may be applied to products, parts,

and processes. It may be applied by the manufacturer, the merchant, or the consumer in the conduct of their individual businesses, but the best and the most far-reaching results are attained through the intelligent co-operation of all interests. The more important of those results are decreased inventories, smaller idle investments, lower selling expenses, fewer misunderstandings and lower production costs; also quicker turnover, volume business, improved quality of product, more profit and better value per dollar spent.

Results of Simplification

As an example of how the elimination of excessive variety may be applied by the producer, a certain manufacturer of shoes formerly made three grades of 2500 styles each but found the burden of this variety too heavy. Analysis of his sales showed that the bulk of his business warranted reducing his line to one grade of 100 styles. He eliminated 98 7/10 per cent of his former varieties with these results: inventories decreased 26 per cent, direct overhead 28 per cent, and production costs 31 per cent; turnover increased 50 per cent, sales of women's shoes 22 per cent and of men's shoes 80 per cent. The cost to the consumer was reduced 31 per cent.

Simplification may be effectively applied in an individual plant or enterprise, but to obtain the greatest savings, it must be carried beyond the individual plant until, by co-operative effort, a national simplification is accomplished which will bring advantages and benefits to all concerned.

Simplification is probably one of the most important means of cutting production and distribution costs, but it cannot be successfully brought about even in a single plant or business without the whole-hearted co-operation of the production, the sales and the financial executives. Similarly, national simplifications are most successful when all interests co-operate. This means not only the trade associations interested in the particular commodity under consideration, but also the non-members, as well as the allied or related groups, in any way likely to be affected by the recommendations adopted. The tremendous wastes now incident to excessive variety in shape, size, quality, composition, and other characteristics of product constitute a large part of the huge deduction from the goods and services we might all enjoy if simplification were more generally applied.

Standardization is the continuous process of crystallizing the best thought and practice of the industry or the art, and coincidently eliminating that of proved lesser quality, utility, or value, as uneconomic, wasteful and destructive. It is the logical outgrowth of constructive effort; it is the measure of progress, and the incentive for further advance. For no sooner has any one thing reached a certain degree of attainment or perfection than effort is concentrated on refining, improving and developing that thing to higher limits of performance, utility and satisfaction, i.e., a new "standard" is sought!

Standards may be divided into four major classes: Standards of measurement; of quality; of performance; of practice. Each of these classes will be described briefly with respect to its application and usage.

Standards of measurement are those used for expressing the quantitative aspects of space, time, matter, energy and motion, and their interrelations. Their purposes are (1) to aid accuracy in industry through uniform and correct measures; (2) to promote justice in daily trade through systematic inspection and regulation; and (3) to facilitate precision in science and technologic research through calibration of units, measures and instruments involved. Such standards are obviously necessary in establishing sizes and dimensions of parts, or units of machines or structures in which interchangeability of those components is essential to ease of assembling, erection and maintenance.

Standards of quality are primarily useful as a basis for fair dealing, and as a means of avoiding disputes or settling differences. Their use promotes precision, and reduces waste in manufacturing, selling and consumption. For example, a manufacturer who guarantees his products to his customers protects himself by securing raw materials of uniform grade and character, for he knows he cannot build certainty of performance, etc., on the uncertainties of unstandardized materials. The lack of quality standards is another great source of waste. Consumers in general today are more insistent than ever before that standards of quality be established for all kinds of goods.

Standards of performance reflect the relative efficiency of machines or men, or both. Definite ratios of output to input are necessary in determining whether or not performance is economical, efficient, and profitable. Such bases of measurement or comparison are very useful to both buyers and sellers in estimating probable results.

Standards of practice are useful in the technical regulation of construction, installation and operation. They involve the factors defining quality, safety, convenience, economy, efficiency and uniformity, and thus provide a basis for agreement of all interests in those matters which have to do chiefly with the protection of physical property and human life. Such standards assist more in the prevention of waste than in its elimination, though it may be argued that conformance with well-established standards of practice eliminates the wastes incident on departure from those standards. In either event, the great advantage in adhering to standards of practice is in the economy, efficiency and safety which result.

Benefits from Standardization

Standardization, consciously applied, means more economical manufacturing. If a manufacturer simplifies his line to those of his products which are in greatest demand, and then proceeds to develop them as his standards, he can, because of the reduced number of manufacturing units, establish larger units of production, which means longer runs and less frequent changes or set-ups. Higher rates of individual production and less idle equipment result from the steady flow of work across his machines. This larger and more uniform machine burden means more effective stock

control, which requires more accurate planning and estimating of production requirements, and thus leads into better control of purchasing, with greater ease in securing raw materials. Better and more simplified inspection becomes possible as does improved material handling. Clerical overhead is reduced, and supervision is more intense or concentrated. In brief, all the advantages of mass production methods become increasingly possible with the further application of standardization. There is, for a given volume of output, a reduction in capital usually tied up in raw materials, semi-finished work, and finished products, as well as in the jigs, dies, templates and special machinery required for variety production. The stock of repair parts for equipment is decreased, and storage space for stocks of all kinds is proportionately lessened. Consequently it is possible for the manufacturer to turn around on a smaller working capital.

Labor becomes more efficient. Training of new employees is simplified, and in these days of labor scarcity, and the necessity of making skilled mechanics out of relatively inexperienced men, this is an important advantage. The longer runs and the higher individual production means better earnings, steadier work, also happier and more contented workmen. Seasonal employment is reduced, and fewer factory shut-downs occur.

Standardization will come to have a greater national significance in the next few years than it has ever had before, because the economic trend demands the elimination of wastes of every kind, and degree.

Better Control of Production Resources

Waste is a measure of managerial ability. The best organized, best managed industries have the least waste, considering waste as expenditure for which there is no tangible return. Conversely, an excessive degree of waste indicates faulty management.

Management, to achieve maximum results, must develop maximum possible control of all factors involved in the effort for which it is responsible in order that it may thus insure the attainment of those results. So long as there is lack of such control, there is waste, in direct proportion to that lack.

The great factors in modern business are: men, materials, machinery, methods, money, and markets. The late Charles P. Steinmetz once said:

> Each of these factors has its waste heap which the manager, who wishes to meet competition most advantageously, will inventory minutely. Men offer us the great savings of the future, our machinery is amazing in its ingenuity, but we have forgotten to apply inventiveness to our labor; yet every lay-off means idle machinery. The entire industrial plant of the world is always in process of being scrapped for the substitution of something better. Getting value from idle men and idle capital, wasted time, lost power, refuse material, making use of what is not now used—that is business progress.

The shortage of labor during the past year has focused attention on labor-saving devices, machinery and methods. The installation of such equipment has in some instances thrown an otherwise smooth working organization out of balance through the acceleration of the particular operation to which it was applied, and the failure to accelerate to like degree the operations which precede, as well as those which follow, the one affected. The resultant effect has been to cause a loss or waste which, for the time being at least, threatens to absorb or neutralize the benefits anticipated. Obviously, the control of physical expansion must be such as will avoid disruption of the main job of getting out the product—yet how often the true correlation and co-ordination of these two projects or efforts is not attained.

Methods of Obtaining Control

The more common methods of developing better control are expressed in the term "stopping the leaks," which implies tracing it to its prime source, as well as determining its volume. This again emphasizes the need for an adequate survey of all pertinent facts before the proper corrective measures can be applied.

The ability to discover those facts and use them intelligently is the essence of executive ability. In the last analysis, elimination of waste through better control of all factors in an industrial enterprise is primarily dependent on the executive ability of those at the head of it. No one who calls himself an executive can afford to rest content with results achieved. He must continually educate himself to a broader understanding of principles and their application to the problems in hand. The present intensity of competition is resulting in more careful study of the ability of men to control the factors of the business intrusted to them. Not only are the executives of the larger organizations being subjected to rigid scrutiny from the angle of results produced, but investigation is being extended to those on whom these organizations depend for the distribution of their products.

Better control in business operations or in any of its subdivisions requires the establishment of standards against which actual accomplishment can be measured. Without such standards, it is not possible to determine accurately whether the maximum result is being obtained from any specific effort. Setting proper standards is a science in itself, in so far as it requires the understanding of what constitutes a practically attainable ideal. Standards may be exceeded, when what is expected is definitely known and understood. In those cases, new standards may be established as the basis of future measurement and comparison.

The opportunity for improved control comes in the constant study of the departures from the standards, and the analysis of their causes. Once these are properly determined, the application of the corrective measures necessary in bringing the actual results closer to the desired ideal becomes a matter of relative cost, to be settled on the basis of whether or not the returns warrant the extra effort required.

That better control is a practical means of waste elimination is evidenced by any number of instances wherein the results obtained, while remarkable, have not even approximated the best known performance.

Westinghouse Shop Express System

Good Management and Layout Cut Costs to $0.044 per Package

By STEWART M. LOWRY

Supervisor of Transportation, Westinghouse Electric and Manufacturing Company

IF there is an opportunity to install some system of shop express package delivery in a manufacturing plant, the laying out of routes forms an important part of the service. In fact, the ultimate economy of the system depends largely upon the correct planning of this detail of its operation.

It is not sufficient to buy two or three trucks and assign them to various buildings or departments. Only by careful study and adjustment can the entire service be arranged so that it will be a real service and help in manufacturing activities.

The principal things to be considered when laying out a system of shop express routes served by industrial electric trucks are:[1]

1. Equitable distribution of the total business to the different routes.
2. Keeping the number of stations on each route approximately equal.
3. Equalizing as nearly as possible the length of the different routes.
4. Keeping transferring at a minimum.

It is desirable, for several reasons, that each route should have an equal or nearly equal share of the total business handled, and this plan has been put into effect in the Westinghouse plant, where three routes are in operation. First, the capacity of each truck is a limiting factor and if there were an unequal distribution of the work, one truck might be greatly overloaded and perhaps not be able to keep the tables on that route clear, while the two trucks on the other two routes in our plant might very rarely be loaded to capacity. Second, unequal loading of the routes is unfair to the driver of the overloaded truck because of the additional handling, for everything he hauls must be loaded on and unloaded from the truck.

Number of Packages Is No Measure

In determining the load for each route, the number of packages handled cannot always be taken as an accurate measure, for some departments make a practice of shipping every item as a separate package, while others combine a number of items into one container and call it one package. Along the same line, there is not as much work involved per package in handling a large number of packages from one department, as there would be in handling that same number of packages collected from as many different departments.

The main object in keeping the number of stations on each route about equal is the effect upon the morale of the drivers. The possibility of one man feeling that he is doing more work than the other two is reduced. Routes are therefore laid out so that each man makes about the same number of stops on each trip. The number of stops made affects the total time required for completing the circuit, which should be, as nearly as possible, the same for each route.

The chief object in attempting to equalize the lengths of the routes is to affect the time schedules for each route similarly. The ideal to strive for is to have the routes so equalized that all trucks will depart from and return to the transfer station at the same time, but the different conditions that are encountered on nearly every trip naturally make this impossible. As the routes are laid out at present, each one is approximately 9500 ft. in length, and studies have shown that the minimum and maximum average times for completing any circuit vary only from 10 to 15 per cent. The better this condition can be made, the less time will be wasted at the transfer station waiting for the delinquent truck.

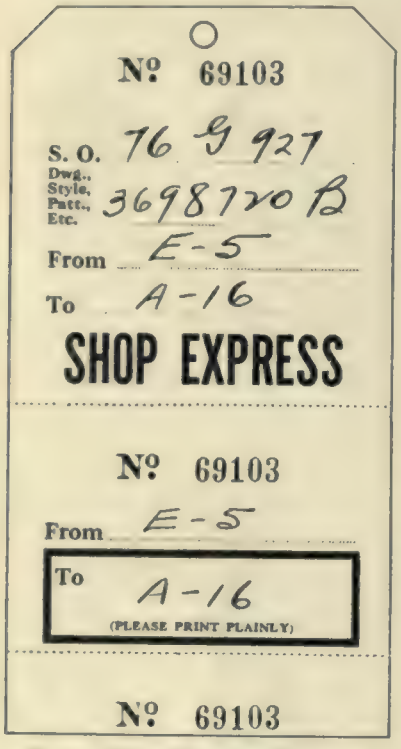
Routes Planned to Reduce Transfers

Transferring and the attendant possibilities of delay and damage to or loss of material are minimized by placing on the same route, in so far as possible, those departments that are heavy shippers to and receivers from each other. Some departments are essentially feeder departments and they have considerable outgoing material and very little, if any, incoming material. Where a feeder department ships a large portion of its outgoing material to a few assembly departments, it is advantageous to have these assembly departments on the same route as that to which the feeder department is assigned, and, if the layout of the shop will permit, to arrange the route so that the truck arrives at the feeder department ahead of the assembly departments. In this way, not only will prompter service between these particular departments be effected, but the material will not go through the transfer station, and the distance that it is hauled will be minimized, thus making the most of the capac-

[1] See MANAGEMENT AND ADMINISTRATION, July 1925, pp. 7-10, for the preceding section of this article.

ity of the truck. Another advantage of not transferring shipments from one route to another is that the material is handled entirely by the one driver, which facilitates tracing lost material, as the entire responsibility is on one man.

In order to have a uniform and wide-spread understanding of the way the shop express should be used,



This part remains attached to material after delivery and serves as an identification of the material in the receiving section.

This part is detached and stamped on the back by the driver when material is delivered. It is filed and retained by the Transportation Department as evidence of delivery.

This part is detached by the shipping section and retained as a voucher.

FIG. 4 SHOP EXPRESS SHIPPING TAG

a set of rules was drawn up and distributed in mimeograph form to all shop supervisors and foremen. These rules are given below:

RULES FOR SHIPPING BY SHOP EXPRESS

One truck is assigned to each of the three routes. Each route will be covered four times daily, according to a predetermined schedule. In order to maintain this schedule, it will be necessary to observe certain uniform rules for dispatching and receiving shipments.

Each station has been supplied with a special table which is to be used exclusively for shop express shipments. Incoming material addressed to any shop section on the accompanying list will be delivered to the station serving that section. Any material within the weight and size limits, which is properly prepared, tagged, addressed and placed on the "outgoing" side of the table, will be collected by the shop express truck, and delivered in the course of its schedule.

The standard container will be our small steel tote pan (24 in. by 12 in. by 6 in.). This does not mean that other packages will not be accepted. Provision is made to carry odd shapes and sizes, but you are requested to use the small tote pan wherever possible.

A special shop express shipping tag (see Fig. 4) which will be supplied, must be filled out and attached securely to every shipment.

Small parts or loose material for the same destination may be placed in one container and the container tagged.

If more convenient, loose pieces may be tied or wired together, forming a bundle, and the tag fastened to the bundle. When doing this, do not tie heavy metal parts together with light cord which might become cut or broken with handling and the loose pieces thus separated from the tag and other means of identification. Use wire for metal parts having sharp edges.

Do not fasten the tag to only one of a number of duplicate or similar loose pieces, expecting the driver to keep them all together. If they cannot be put into a separate container or tied into one bundle, attach a separate shop express tag to each piece.

A single piece, such as a small casting, need not be placed in a container, but the tag should be attached securely to the piece.

Small cotton bags are suggested for a few pieces of small parts.

No single unit or package should weigh more than 100 lb.

The following procedure should be followed in making a shipment by shop express:

1. Consult the accompanying directory to see if the shop section to which you desire to ship is listed. Do not use the shop express if the destination section is not on this list, for there are no delivery facilities and material is apt to be lost. If you have frequent occasion to ship to a section that is not listed, a request should be made that service be extended to include that section. If the section to which you desire to ship is not listed *do not* address the tag to an adjoining listed section, in the belief that the listed section will see that the material reaches its destination. That section cannot be expected to take particular interest in material that does not belong to it.
2. Fill out the shop express shipping tag completely, showing shipping section, destination section and identification of material. Print address plainly. *Address to the shop section—not to the shop express station.* One station frequently serves a number of different sections. Address tags specifically. For example, we receive tags addressed to section M. The driver cannot tell, without referring to the paper work attached to the material, whether it is intended for M-Packing, M-Storeroom or M-1 Polishing and Plating Department, for there are these three different stations in the M aisle.
3. Transcribe the shop express tag numbers to the papers involved in the shipment, as "interworks delivery" slips, requisitions, etc. These tags are numbered serially to facilitate tracing lost material.
4. Tie tags securely to the shipment, making sure that each unit or package has a tag. Any papers that are to accompany the material should be folded to a small area (at least as small as the shop express tag) and pinned securely to the back of the top section of the tag. Do not pin to the lower section because that section is removed by the driver when material is delivered. Pins are better than paper clips for this purpose because there is less likelihood of the papers being pulled off and lost in handling.
5. Detach lower part of tag and retain with other paper work as voucher.
6. Place shipment on the "outgoing" side of the table at your station, from where it will be collected by the shop express truck on the next trip.

RECEIVING RULES

Keep "incoming" side of table clear. Do not use the shop express table for the storage of any material other

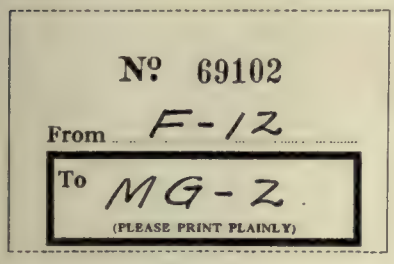
than that which is immediately "outgoing" or "incoming" shop express shipments.

Check material received with accompanying papers, sign receipt and mail to the issuing section immediately.

If material which belongs to another section is left at your station, notify the driver on his next trip or call the works transportation office, where inquiries regarding lost material or other complaints may also be directed.

Procedure of Truck Operator

Each truck operator is required to make four complete trips over his route daily. He follows the same prescribed route on each trip and, in going his rounds, he collects from and delivers to any or all of the sta-



Middle part of tag, as shown in Fig. 4, detached by the driver.

Stub stamped by the driver to show that package has been delivered.

FIG. 5 SHIPPING TAG STUB RETAINED BY TRANSPORTATION DEPARTMENT

tions on his route. When he arrives at a station, he takes from the "outgoing" side of the table all material that has been properly prepared for shipment. If he has material on his truck for one or more of the sections served by that station, he leaves it on the "incoming" side of the table, detaches the second and last stub from the tag, and stamps the back of it with the rubber stamp kept in the drawer of the table. Fig. 5 shows the front and back of the stub detached and retained by the driver. This stamped stub is equivalent to a receipt for the shipping section. At the end of the day, these stubs are turned in to the office of the works transportation department, where they are sorted and filed numerically for future reference in case of complaint that material was not delivered. These stubs are kept for several months and then thrown away. The main body of the tag remains attached to the material for identification purposes in the receiving department, and is disposed of there when the material is used.

Volume of Business

Since its inauguration in August 1924, the shop express business has been steadily growing, having handled in the first 7½ months of its operation nearly

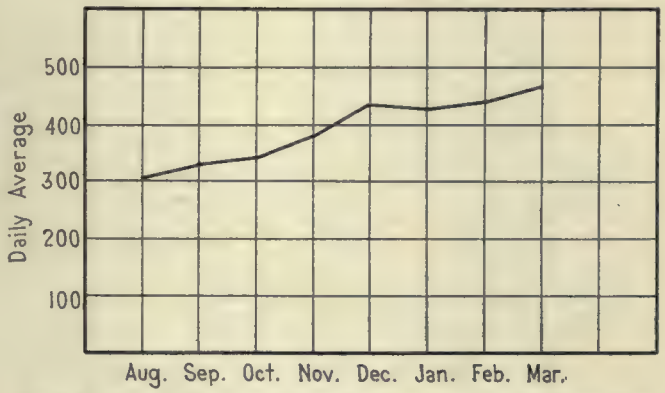


FIG. 6 CURVE SHOWING INCREASE IN AVERAGE NUMBER OF PACKAGES HANDLED DAILY BY SHOP EXPRESS

68,000 packages. The curve in Fig. 6 shows the average number of packages handled daily from August 18, 1924 to March 31, 1925. It will be noted that the daily average has increased about 45 per cent. From the stubs turned in daily by the drivers, records are compiled showing the activity for every individual shop section. Fig. 7 shows the form of this record card and the actual figures for one particular shop section from February 1, 1925 to March 31, 1925. Each column provides for a week and is headed by the date of the first day in the week. On the upper half of the card is recorded the number of packages received by the section daily and on the lower half the number shipped. The activity is totaled for each week. It is apparent at a glance whether shipments exceed receipts, or vice versa, which is useful information when

SECTION F-13			STATION 8		ROUTE		2		
WEEK	2-2	2-9	2-16	2-23	3-2	3-9	3-16	3-23	3-30
Received									
MON.	11	13	16		22	15	20	10	13
TUES.	11	[illegible]	17	8	18	8	22	8	11
WED.	11	21	7	13	7	8		18	
THURS.	11	10	18	10	[illegible]	13	1	15	
FRI.	10	7	4	7	8	8	9	26	
SAT.	[illegible]	4	[illegible]		[illegible]		1	2	
Total	57	63	68	38	72	52	53	79	
Shipped									
MON.	10	10	12		23	2	4	[illegible]	7
TUES.	12	7	3	2	8	6	10	6	4
WED.	5	5	4	1	5	1	16	13	
THURS.	6	6	15	4	5	24	10	5	
FRI.	11	13	7	7	4	9	1	7	
SAT.	12	5		1		4	6	3	
Total	56	46	41	15	45	46	47	40	

FIG. 7 CARD FOR KEEPING RECORD OF SHOP EXPRESS ACTIVITY IN EACH INDIVIDUAL SHOP SECTION

revising routes. An inactive station is also readily detected, and if the amount of business does not appear to justify retaining it and having the shop express truck call there four times daily, the station is discontinued and the table held in reserve or transferred to a new location. These changes generally call for a

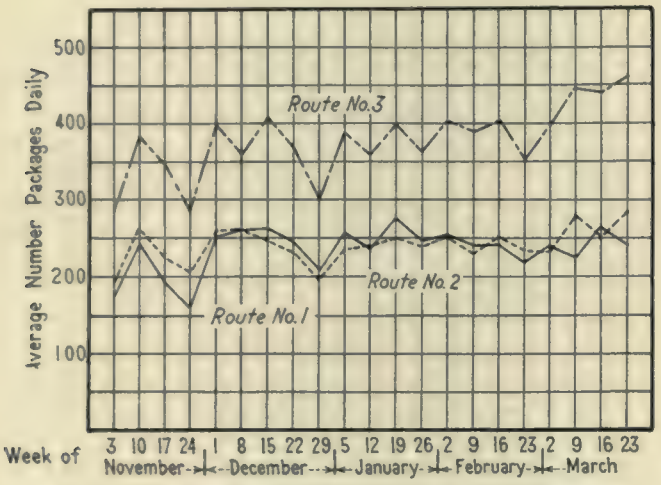


FIG. 8 CURVE SHOWING DISTRIBUTION OF SHOP EXPRESS TO THE THREE ROUTES

revision in the routes, which at present are laid out as shown in Fig. 3 of the previous instalment of this article.

Study of Individual Routes

Segregated records are also kept showing the volume of business on each route. The curve in Fig. 8 shows this relationship over a period of five months, from November 1, 1924 to April 1, 1925. In making up this curve, shipments were added to receipts, since each

TABLE 1. SHOP EXPRESS DELIVERY COSTS

Fixed charges on electric trucks:		
Interest on investment ($1,865 at 5 per cent)	$ 93.25	
Depreciation (15 yr. life, $1,865 cost)	124.50	
Upkeep and repairs for 1924 ($13,854.63 for average of 76 autotrucks)	182.29	
Power charge ($13.70 per month for 1924)	164.40	
Total annual fixed charges per truck	$564.44	
Total annual fixed charges for 3 trucks		$1,693.32
Charges on shop express equipment:		
Interest on investment ($868.91 at 5 per cent) (tables, signs and filing trays)	$ 43.40	
Depreciation (10 yr. life, $868.91)	86.89	
Upkeep and repairs (estimated from figures for six months)	242.14	
Total annual charges		372.43
Wages of operators:		
208 hr. per month at $0.46 ($96 per month for 3 men for 12 months)		3,460.00
Total annual cost		$5,525.75
Monthly cost (12 mo.)		$ 460.00
Weekly cost (52 wk.)		$ 106.00
Average number of packages handled weekly from December 1, 1924 to February 15, 1925 (excluding the weeks of Christmas and New Year's)		2,433
Average delivery cost per package		$ 0.044

involves separate handling, that is, each package must be handled once when it is collected and once when it is delivered. Hence, the aggregate of these curves will be just double the readings of the curve in Fig. 6 at corresponding points. Any decided and sustained change in the relative positions of these curves would indicate that the routes should be revised. It is not always necessary to keep equal the volume of business on each route as measured by the number of packages handled. As was said previously in this article, a large number of packages from the same place can be handled much easier than the same number from many different places. This is illustrated in Fig. 8, where Route 3 appears to be handling more business than either of the other two. However, a large number of the packages handled on Route 3 are collected from one feeder section, and in reality the driver on this route has no harder job than either of the other two.

Analysis of Costs

One of the vital questions that rightfully may be asked about any plan is: "How much does it cost?" In arriving at the previously mentioned cost figure of $0.044 per package, the total operating costs over a period of time were divided by the number of packages handled. The best way to explain the figure of $0.044 is to present a brief analysis of the total costs and show how it was derived. This analysis is shown in Table 1.

As business has increased, the transportation cost per package has, of course, decreased as shown by the curve in Fig. 9. Between August and March the drop was close to 40 per cent.

Perhaps the best testimonial of the success of the shop express is to be found in the fact that it is used voluntarily. The very nature of the plan forces it to

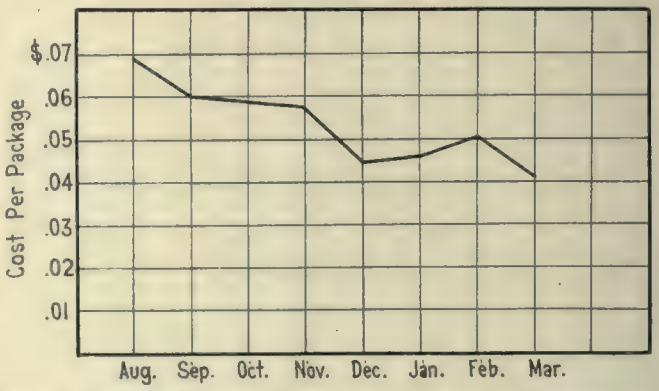


FIG. 9 CURVE SHOWING DECREASE IN AVERAGE TRANSPORTATION COST PER PACKAGE HANDLED BY SHOP EXPRESS

stand on its own merits. The existing transportation facilities of the various departments were in no way curtailed to make way for the shop express. It was not forced upon the shop supervisors as a substitute for previous methods, but was in reality a supplementary service which they were free to use or not, according to their judgment. Obviously, if they had not felt that it was a better, cheaper and more efficient way to deliver small packages, they would have continued to use the old methods, and finally, the shop express would have been abandoned as an impracticable scheme. Its survival and continuing growth, to say nothing of the enthusiastic support that it has received from the departments served by it, may be taken as the practical endorsement of a sound theory.

Dangerous Selling Prices

Avoided by Knowledge of Economics of Pricing and Analysis of Industry and Its Markets

By W. L. CHURCHILL

Consulting Engineer

SEVENTY per cent of American manufacturing industries earn less than $5000 per year net profit. This fact, compiled from government reports covering all industries listed as "manufacturing," indicates a low level of average earnings as a result of activities calling for more than ordinary skill, ability, initiative, experience and investment.

It may be argued that the more than 200,000 manufacturers included in this classification comprise many who employ but a few people and to whom $5000 profit would be equivalent to millions earned by larger concerns. Against this may be offered the opinion that anyone embarking in a manufacturing enterprise with expectation of averaging to earn less than $5000 per year profit, has small appreciation of his value, and of the risks he is taking with his own or his investors' money and credit. Neither do the other 30 per cent of manufacturers make such extravagant earnings as to permit investment in manufacturing enterprises as a whole to show returns that are at all comparable with the services rendered.

What is the reason for this situation? As a nation we have led the world in the production of articles, and in the development of devices and commodities to produce. Manufacturers have been and are constantly striving to turn out more per person employed, and to reduce the prices of their products to consumers so that there may be more goods consumed. This has been done in the face of increasing wages, salaries, and unit costs generally.

Unfortunately for the manufacturer, he has done such a good job at production that he has overtaken distribution. Neither can he fairly blame the World War for all of his troubles in this direction, although it did greatly stimulate his activity toward development of methods for maximizing output, and definitely and quickly elevated standards of living, wages and salaries.

Many manufacturers blame their poor showing upon the greatly increased productive capacity, and the World War as responsible for that capacity. At the same time they live in the hope that some day consumption will overtake capacity and profits will follow. As a matter of fact, even industries that were restricted by war operations are in as deplorable a situation in regard to lack of profits as many that were specifically brought into being by the war.

No, the trouble is not due to over-capacity, or over-production, but to unintelligent (to express it mildly) pricing. It is unintelligent pricing that has insidiously lowered earnings in manufacturing enterprises to an extent that, despite the better wages of manufacturing employees and the improved salaries of the executive and administrative forces, has penalized the stockholders who not only obtain less today per dollar of dividend received but obtain fewer of these dollars as a return on their investment in manufacturing enterprises than formerly.

There is no question as to our increased production per employee, as witness the recent survey report of the Industrial Research Bureau to the effect that production increased 185 per cent in 25 years while the number of wage-earners increased but 90 per cent. This report also states that labor has definitely fallen off since 1914 due to administrative and technical improvement in utilization of both labor and power. A recent report issued by New York State Industrial Bureau, shows exactly the same number of persons employed at gainful pursuits in 1924 as in 1913.

The Lower Profit Margins

To encourage still further increase in production the manufacturer has lowered prices until profit margins have become extremely narrow as compared with earlier years, and slight errors in estimating or calculating costs of production and distribution, or the possible consuming ability of his trade, or of his organization to dispose of his product, leave him with lessened profits or actual losses.

One of our largest associations of manufacturers recently prevailed upon a man who had retired from that particular business about 12 years ago, to act as their secretary and general adviser in efforts to put the industry on a more healthful basis financially. This association had undertaken a typical program of uniform cost system installation and one of the first duties of the new secretary was to stimulate and develop interest in this work. He was amazed at the change in profit margins that had developed since his active connection with the industry, saying:

> We used to add labor, material and overhead, then put on 33⅓ per cent for profit. Of course, we didn't make that profit because errors and omissions would bring it down so that we sometimes ended the year with as little as 15 per cent net. But say, look at these cost sheets! Why, these fellows are only adding 15 per cent and some only 10 per cent! No wonder they wind up the year with a zero profit

or a deficit! I wouldn't dare to do business on such a narrow margin, as a few errors or omissions that are almost inevitable will wipe it all out and maybe something besides.

Neither has uniform costing been able fully to correct the evil of unintelligent pricing. In some instances it has had a directly opposite effect or perhaps it would be fairer to blame faulty application of uniform costing, as in the case of one of our oldest established job printing businesses located in the Metropolitan District. It had adopted and was using religiously (too religiously it was afterwards proved) a system of costing and pricing recommended by an associated group of printers who were earnestly trying to improve the general status of their industry.

Now, in the Metropolitan District there are something like 1500 job printers. This particular firm had from its long years of activity and progressiveness developed much technical skill, accumulated equipment for high-grade multi-color work, and unusual artistic taste for producing attractive catalogues and other better class printing. For a period of several years after adopting the uniform cost system their business shrunk progressively until it was down to about one-half former proportions, and growing deficits precipitated an investigation into the causes. Fortunately, the reason was found in the faulty pricing principles that automatically over-priced all quality products while under-pricing the so-called chicken-feed business of letter-heads, cards, envelopes, etc. Their salesmen had given up practically all effort toward securing large orders for high-grade work as they had invariably found themselves under-bid. This left most of their larger and more expensive equipment idle while their little jobbing presses were swamped with what was proved to have been a very unprofitable business.

Correcting their faulty pricing principles soon restored their business to a profitable basis.

Under-Pricing Not Only Danger

This case is cited to show also that unintelligent pricing is not confined to under-pricing. Neither are such combinations as over-pricing to drive business away, and under-pricing to encourage unprofitable business, confined to job-printing. Nearly every sizable industry making a product or a variety of products with wide range of values suffers from this insidious evil. Some do so knowingly and trust to the "law of averages" to enable them to overcome the tendency to lower profits, but in most cases it exists from faulty ideas as to how profits should be applied to products, to arrive at selling prices.

In one of the clothing industries, making a standard line of wearing apparel, the cost sheets of three standard articles of one firm, selling at $15, $40 and $120, were priced according to six different methods of applying profits, used in the industry by different members with the following results: The $15 article according to one manufacturer ought to sell for $14 as at $15 it was bringing an exorbitant profit. On the other extreme was a manufacturer who contended it should bring $27, and that it could not be sold profitably for less. Here is a difference of almost 100 per cent in supposed correct selling prices, both built from the same cost and each aiming at the same amount of annual profit on the same assumed volume of production.

The explanation lies in the pricing of the $120 goods, as No. 1 who priced the $15 article at $14 contended that the $120 article should sell at that price to insure the designated profit, while his neighbor, who demanded $27 for the low-priced article, contended that according to his way of profiting it only needed $79 to earn the profit desired.

The $40 garment was priced at that figure by all but one of the six, who figured that $34 was the fair selling price. On the other grades there were two who priced alike and correctly while four were high on one and low on the other. They all averaged to earn the same amount.

Now, when you can get differences of nearly 100 per cent in supposed fair selling price from exactly the same cost, aiming at exactly the same profit total for the year and the same total number of units produced, it is easy to understand why an industry can be, on the whole, very unprofitable.

Of course, the low-priced party in each line sets that price for his competitors to meet, and no matter how honestly he has established that price nor how accurately he has figured his costs, to his competitors he is a "price-cutter," and is usually referred to with uncomplimentary expletives prefixed to the term.

He in turn finds that in some other class in his line someone else is away under-pricing him, and no matter how honestly the latter price has been arrived at, nor how accurately it was costed, it is "all wrong" in his opinion and the firm naming it is the "price-cutter." The trouble is chiefly a difference in ideas as to the minimum volume of business on which profits should be earned, and how profits should be applied; to a lesser extent faulty cost conclusions and different profit ideals enter.

There are a few manufacturers still who believe that they are engaged in a cave-man warfare and that success in business simply means the survival of the fittest. "If they beat the other fellow to it they may win out."

Happily this notion is fast disappearing as it is no longer an effective means of permanent success. Most manufacturing enterprises require more or less special equipment for their special product and no matter how many firms or how often the management of a plant may fail, the equipment stands ready to go into production and some way, somehow, somebody gets it going again. Corporations may die, but unlike humans they do not stay dead. When resurrected they are apt to be worse competitors of those who put them out of business than before.

Impossible to "Beat Other Fellow"

Besides all of this, with the development and improvement in financing methods, the many mergers, combinations, and affiliations of industries with one another, it is becoming increasingly difficult to land a

permanently effective knock-out on any one of them.

A recent survey of one industry of some 40 different firms illustrates this quite definitely. Of the 40 only 10 depended absolutely on the one product for their existence. The remaining 30 had other products representing from 30 per cent to 95 per cent of their activities. Of the 10, four are owned by estates not entirely dependent upon them. Two are owned by individuals of sufficiently large means to carry on indefinitely even at unprofitable levels if necessary. One of the remaining four is being operated by a receiver and the others are so well connected with banking interests that it is doubtful if they would be allowed to remain long out of production even if forced for a time to operate unprofitably by some ruthless price-cutting firm that might undertake to monopolize the field.

No, it is practically impossible for a lone "fittest" or a few lone "fittests" to survive a "price-war." All survive but none or but few as "fit."

Price-cutting is almost always—in the beginning at least—simply accidental, unintelligent pricing and not deliberate warfare. Nor is this lack of intelligence confined to small irresponsible firms. It is just as apt to prevail in the largest and most highly organized industries. One of these was a constant source of irritation to an industry in which they were a large factor, but to which they contributed only a portion of their production. Complaints against them were so persistent and violent that they decided to have their methods of pricing reviewed to determine whether or not they might unintentionally be under-loading their costs. This proved to be the case to the extent of bringing about an addition of more than 60 per cent to the general overhead costs of this product that had formerly been charged to their other and more extensive lines. They had never had any intention of quoting prices unfair to themselves and had done so only from the assumption that their figures indicated they could produce much more cheaply than others. Meantime their other products had been showing less favorable returns than they felt they should.

Examples of Unintelligence

Another equally large firm were approached in regard to a line of their manufacture that represented only about 5 per cent of their total output, but on which they were quite vigorously accused of selling at a loss to themselves and compelling firms dependent upon this line for their existence to sell at ruinous prices when in competition with them.

They asserted that they never intentionally sold at a loss, but admitted that they had not attempted to segregate the profits or even the selling and administration expenses of this line although carefully compiling their factory costs. When asked how they were sure of selling at a profit when they had neither of these factors specifically figured in their prices, they answered: "We know we can produce as cheaply as anyone in the business and we meet any price offered when we want that business."

This is not an uncommon and unintentional cause of unintelligent pricing and is apt to be aggravated by the smaller and less thoroughly organized firms, who assume that because the "big fellows" are figuring accurately, they are safe in quoting similar prices and even "nipping" under a bit to get their share of business, because "of course, we can produce cheaper as we haven't their big overhead." Both, big firms and little ones, have very decided illusions in regard to their respective advantages. The small firm president says: "Look at the X Company! Their president gets $50,000 a year while I only draw $7,500." He ignores the fact that the X Company produces 40 times what he does, so that all of the officers' salaries combined do not equal the cost of his in the respective units of production. On the other hand the X Company tells you that "Y doesn't know his costs, while we figure ours out to the 4th and 5th decimal and know every day just what we are doing." They overlook that Y's business is so small that he does not need the same array of detail figures, as he is in such intimate personal contact with most of the details of his business. Both X and Y reach somewhere near the same conclusion as to the prices they ought to get, then each quotes below the other's price for the competitive business it wants, on pure assumption that each can produce and sell cheaper than the other. Here it is again, unintelligent pricing, pricing from assumption rather than knowledge, or from motives of retaliation and even vindictiveness. Is it a wonder that everybody loses?

Then there is the small man ambitious to get established and who is an easy mark for buyers whose job is to get goods as cheap as possible. An extreme case illustrating this factor in unintelligent pricing was that of the young man who had been a good factory manager, being suddenly offered the rental of a plant all equipped to run (but having been closed for over a year) at a very nominal figure, and a contract to take his production at prices to be agreed upon each month. He secured sufficient backing to get started, but the prices he offered to furnish the product for were not acceptable to the contractor so he was forced to go direct to the trade for his business. He found a buyer willing to give him sufficient business to enable him to run 24 hours per day for six months, if he could get the price down low enough. This he did, secured the contract, then found it necessary to run Sundays, as he expressed it, "to make my profit, as I only make my costs week days."

Of course, his price was ruinously low and invited retaliation measures from a very much larger firm that had formerly had the business and did not propose to let it be taken from them by such drastic cuts. They offered to "more than meet" any future price quoted. Fortunately, the young man got his lesson and refused to be caught again, but he had established a low price level hard to elevate.

It has already been shown that uniform costing is not a positive safeguard against unintelligent pricing, but to further show how the wrong system of a single detail even if adopted by two people in the same line can introduce unfair competition, the case of two firms of similar size in the same line who installed the same system is quoted. Both did approximately $200,000

worth of business. The system introduced convinced one firm that it had about 4 per cent advantage over the other in costs. While this seemed to be the case, a check-up revealed that the system of depreciation was making one firm charge off $8500 per year and the other $450 for the same items. Here was a case of perfectly innocent price baiting that could have made a serious depression in price level.

Differences in Profit Ideals

Then there are the differences in profit ideals that cause differences in selling prices of similar articles made at similar costs. There is the firm whose owner may be of semi-philantropic turn, and who is satisfied to make no profit whatever, while in the same industry there may be other firms whose stockholders demand that a reasonable dividend be earned on their investment; it is not uncommon to find this factor alone responsible for 10 to 15 per cent difference in what is considered fair selling prices. Of course, the whole industry is forced to a lower level of prices by the low profit ideals of its least ambitious members.

Even normally constituted firms have very different standards in regard to what should constitute satisfactory profits. One firm when asked to name the minimum satisfactory annual profit return for its business, will promptly quote $250,000 while a competitor of the same size will give $100,000 as entirely adequate.

Equally divergent ideals in regard to salaries also exist and it is interesting to note that ideals on profits and on salaries are usually parallel. The firm that aims for substantial profits is usually willing and able to pay equally substantial salaries, while those firms whose profit requirements are less ambitious are more apt to be sparing in their salary lists.

It likewise follows that the more ambitious firms are apt to be the more progressive, for even if they do not realize their profit ideals, they generally have more to spend upon improvements, experimental and development work and thus keep ahead of the procession.

Unfortunately, even the most progressive firms and those who most thoroughly and accurately know just what they should have in the way of fair prices for their products, are in all too many instances prevented from obtaining these prices because the general price levels of their industry are inadequate for fair return. They seek a way out by further cost reduction but no sooner effect one reduction than another comes up.

A typical case is that of a firm needing about $250,000 addition to their profits. They had made them in the past, but of recent years the profits had shrunk year by year until it was decided that some drastic cuts were necessary to restore the old level of earnings. When their engineers were given the problem to solve, they disclosed that it meant making a cut equal to 75 per cent of the pay-roll or an equal proportion of the overhead. Obviously both of these moves were impracticable and it was finally decided that the time had come to get dividends from customers.

From force of long established habits, the first place the average manufacturer looks to find his missing profits, is in his factory costs. He still finds opportunity to enhance these profits by cost reductions, but when cost reductions are dependent upon substantial enlargement of output, it is not always practicable to find the additional markets quickly.

When the problem is put up to the sales department, the latter says: "Give us low enough prices and we will fill your plant with orders." This they do perhaps for a short time by taking competitors' business until the latter awaken to what is going on and "meet prices" whether they can afford to or not.

Then the "buck is passed" to the sales department and its members are accused of being "only order takers—there are no salesmen any more," the accuser overlooking the fact that he accepted the orders "taken" and even insisted that they "get the business somehow, but get it."

Summed up, the American manufacturer has been so busy developing products, methods of low cost production, and hunting for markets, that he has not given much thought to the question of adequate and equitable pricing. The most vital element in his success is given the most casual and off-hand attention. He orders a clerk to "add X per cent for profit" then tells his sales department to "shade it a bit if you have to" and trusts that all will come out all right; a bad year or two will soon be offset by good years. And so he goes optimistically on.

But he is beginning to realize that he must give this matter more intelligent consideration. Besides, his stockholders are beginning to demand something better than explanations for unsatisfactory returns. They want dividends, as a steady performance.

When our manufacturers undertake to solve this problem and correct the evil of unintelligent pricing, it will be corrected. A few industries are already at work upon it with good promise of ultimate success and by methods that are thoroughly practical, simple, and quickly effective.

Cure for Dangerous Prices

How can this be accomplished? It is being accomplished by combined individual education of members of an industry in economics, and by dissemination to the members, of general information in regard to their trade as a whole. These two elements are comparable to (1) screening the individual home against the intrusion of germ carrying insects, and (2) draining the breeding places of these pests to destroy them.

When every member of an industry is versed in sound economic principles in regard to pricing his products, he will not deliberately sell his goods at a loss. When he is fully informed as to the movement of products in his line, he will not be stampeded into quoting prices unfair to himself in efforts to obtain business he should not take.

The recent Supreme Court decision now permits him to join with his neighbors in draining the breeding places of unintelligent prices, and when he uses the same economically sound principles as all of his competitors in determining his own selling prices, then he has his individual business well protected

Southern Furniture Plants Apply Modern Management With Success

The Plant, Its Arrangement and Service Facilities

By CHARLES F. SCRIBNER

Management Engineer

TO show the growing importance of the furniture manufacturing industry in the South, Table 1 has been compiled from the biannual reports of the Department of Labor of North Carolina, the principal southern furniture producing state.[1]

Until 10 years ago, the greater portion of furniture made in the South was of a class termed by the trade as "cheap." It was made of native oak, which was seldom properly kiln dried, by help which had not been trained in factory methods, and who looked upon "public work"—as factory work is generally designated—as a restriction of personal rights and liberties.

Today a marked change has taken place in the industry. The product is now attractively designed, well constructed by skilled workers, and is finished equal to the same class made in any other section of the country. The lumber used is principally gum, with walnut, mahogany, and other veneers. The product has been up-graded to "medium grade," and receives favorable attention at all of the furniture shows of the North.

TABLE 1. PROGRESS OF FURNITURE INDUSTRY IN NORTH CAROLINA

Year	No. of Plants	Average Plant Value	Average Employees per Plant	Average Pay-Roll	Average Output	Average Wage	
						Max.	Min.
1919–1920...	124	$119,045	75	$59,147	$258,925	$4.74	$2.52
1921–1922...	107	78,353	81.2	51,000	283,053	5.00	1.91
1923–1924...	99	109,149	113	78,786	420,402	5.75	2.06

Handicaps to the Industry

However, southern furniture plants generally have been started in a small way, with meager equipment, limited capital, and in buildings which have often caused heavy indirect charges to the cost of production. Some plants have, to a large extent, outgrown these handicaps and are now adequately financed, have installed modern equipment and have improved their buildings, but a considerable number of medium-sized plants are still compelled to operate with buildings which seriously limit output and which prevent their securing a satisfactory and proper profit in a highly competitive industry.

The losses arising from ineffective plant and department layout and arrangement in furniture manufacturing may be classed as follows:

1. Losses of time in moving materials and parts from one place to another.
2. Loss in productive capacity through having the machine operators do the moving.
3. Loss in output through excessive time required to process an order from start to finish.

Considering a few of these losses in the different phases of the work, we have the following:

Lumber Handling in the Yard. There is too much manual handling of lumber from its receipt as raw material to its being put into process at the first machine operations. As a result a plant which has not adopted an effective material handling policy pays from 1.4 to 1.6 times what the more progressive plant pays per 1000 bd. ft. of lumber handled.

Handling Lumber at Cut-Off Saw. When lumber is delivered from the dry kiln to the cut-off saw, the general practice is to unload it on the floor, then bring up one board at a time to the saw table. This plan requires the services of two men at the cut-off saw, with an additional man to unload from the kiln trucks. By the introduction of a lumber lift it has been found that one man—the cut-off saw operator—can handle this operation without assistance, and produce the same amount of cut stock as previously required three men. The savings resulting are shown in Table 2.

TABLE 2. SAVINGS IN USE OF LUMBER LIFT

Cost of Operating Lumber Lift	
Depreciation $2,000—10 yr. life	$ 200.00
Average interest, $6\% - \frac{11}{10} \times \frac{\$2,000 \times 0.06}{2}$	66.00
Insurance at 2%—$2,000 × 0.02	40.00
Repairs, maintenance and power	150.00
Labor, 1 man × 280 days × $3.20 per day	896.00
Total annual operating cost	$1,352.00
Cost of Hand Method	
Labor, 1 man × 280 days × $3.20 per day	$ 896.00
Labor, 1 man × 280 days × $2.80 per day	784.00
Labor, 1 man × 280 days × $2.70 per day	756.00
Total annual operating cost	$2,436.00
Net saving per year	$1,084.00

In moving materials in process in the machine room, considerable loss is incurred through not providing a sufficient number of trucks so that materials will not be placed on the floor and thus require re-handling

[1] For preceding article see MANAGEMENT AND ADMINISTRATION for June 1925, pp. 521-524.

before they can be moved to the next operation. The wood parts entering into the construction of furniture are bulky and require considerable room. Unless they are kept on trucks from each operation, the cost of re-handling will easily amount to one-half that of machining at certain operations. The cost of trucks is no small item, so that it is necessary that parts be processed quickly in order that trucks may be released.

In one plant the writer recently found 40 per cent of the work in process piled on the floor. At the same time there were 14 trucks standing idle in another department. The speed with which woodworking operations are performed and the limited quantities of any one part in the medium-sized plant call for a correction of this matter of interdepartment trucking by placing it in the hands of a move-man acting within the department. By this change of method some surprising results have been secured in processing an order in the machine room, through eliminating the wastes and losses of time which older methods occasion.

The medium-sized furniture plant does not lend itself to the installation of conveyor systems, because of the wide variety of parts and the short time required to machine individual pieces. When the parts are machined and delivered to the cabinet department for assembly, conveyor systems have been found of advantage in cabinet department operations. They also find a profitable field in the removal of sawdust and waste from certain machines to the boiler room.

In the moving of the assembled units it has been found best to insert temporary "glides" in the legs of the units and slide the units on well-kept floors, which are generally of maple that has been oiled to permit free and smooth movement of the units.

Where a two-story factory building is used, and it is this type of building which is generally most economical in the South, the work is moved from the finishing department on the second floor to the storage and upfitting departments on the first floor, by letting it down angular slides. These slides are lined with sheet steel and afford an inexpensive and quick means for moving a large quantity of bulky and awkward product in a short time.

Economical Plant and Department Layout

An economical and effective layout and arrangement of a medium-sized furniture plant making bedroom furniture is shown in Fig. 1. This plant is arranged for straight-line production, from the unloading of the lumber from the cars to the shipment of the finished product.

The plan followed was to sort and grade the lumber as unloaded, piling it directly on the kiln trucks according to kind, size and grade. These kiln trucks were then moved to the yard at the entering end of the dry kilns and one handling was eliminated. Cutting 6000 bd. ft. per day, a force of three men, including one inspector-foreman, was required to unload, grade, load kiln trucks, and move them to their place in the yard, as well as load and unload the dry kilns.

Fig. 2 shows conditions as lumber was unloaded from the cars previous to the adoption of a policy of storing all lumber on trucks, ready to be moved directly into the kilns.

It has been found necessary to keep in mind certain principles when laying out a new plant or when making an effective re-arrangement of an existing plant. Some of these principles may be summarized as follows:

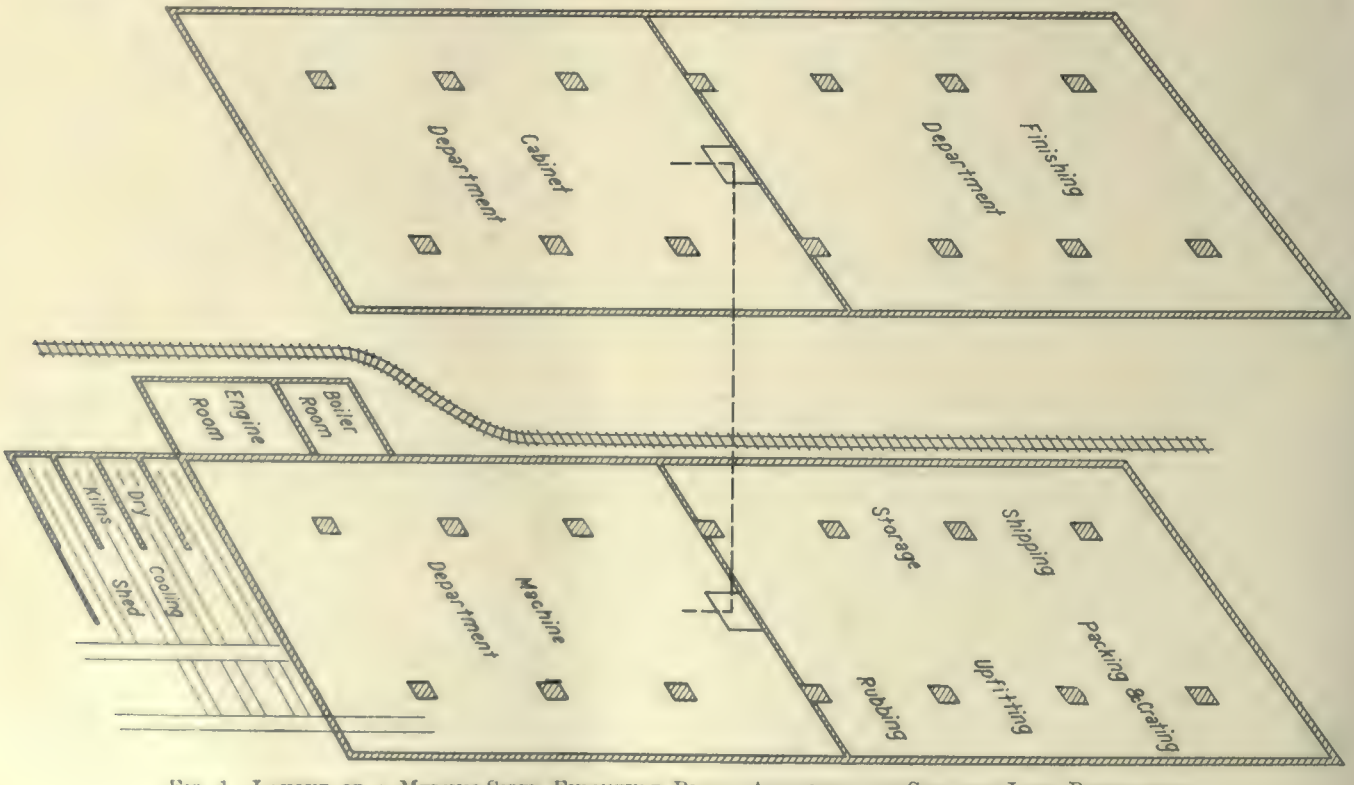


FIG. 1 LAYOUT OF A MEDIUM-SIZED FURNITURE PLANT ARRANGED FOR STRAIGHT-LINE PRODUCTION

1. Provide for future expansion of the plant.
2. Maintain a correct balance of departments as to their relative location and floor space.
3. Keep in mind a straight-line flow of work without any back-tracking in manufacturing operations.
4. Provide ample accumulation spaces for work in process, especially in machine room and cabinet department.
5. Locate service equipment, such as saw filing machines, knife grinders, belt lacing machines, etc., as near to the machine room as possible.
6. Provide adequate storage for tools, samples, etc., to cut travel from work places to a minimum.

For the kiln drying of lumber used in furniture manufacturing, there are two types of dry kilns which claim attention. Each one of these types has its advantages for certain purposes and under certain conditions. The first type, known as the progressive kiln, provides for the lumber to enter the loading end and it is moved forward as the humidity is decreased, temperature increased and the drying operation completed. In this type a continuous stream of loaded trucks is passing through the various sections of the kiln, from the receiving to the discharging end.

FIG. 2 CONDITION OF YARD BEFORE ADOPTING TRUCK STORAGE

The second type of kiln, known as the compartment kiln, receives three or four truck loads of lumber in one compartment, then the conditions within this compartment are controlled from maximum humidity and minimum temperature, to minimum humidity and the correct temperature, until the desired moisture content is secured in the finished material.

The range of stock handled in the average southern furniture plant is from ¼ to ⅝ in. thickness and comprises gum, chestnut, poplar and oak. As each of these contains a varying moisture content when the lumber is received and as they are used in varying quantities, depending upon the particular product that is to be produced, it will be readily seen that a proper planning and routing of lumber through the progressive type of kiln presents problems which are complicated in the extreme where maximum production is the desired end, and which are not encountered in the elasticity of conditions surrounding the use of the compartment kiln. As a result, it has been found that the average plant will secure better service from the compartment type of kiln, in an adequate supply of the several kinds and sizes of raw material required for efficient production.

To secure the best results from lumber it is found necessary to allow it to remain in a cooling or tempering shed for a period after it has been removed from the kiln and before it is delivered to the cut-off saws. On leaving the dry kiln the moisture content has been brought down to about 5 per cent, but during the cooling it absorbs some moisture, so that when delivered to the machine room the moisture content is from 6 to 8 per cent, which is found satisfactory.

Numerous devices are on the market for "automatically" controlling the temperature and humidity within the dry kiln. The general experience with these devices, where a variety of stock is to be treated, may be summed up in the words of a prominent dry kiln expert: "The best control for the dry kiln is a careful operator." At the same time recording thermometers, recording psychrometers and other control instruments will assist the experienced and conscientious operator in obtaining a reduced drying time and a better quality of product from his kilns, provided they are properly used and are not assumed to take the place of sensible action.

Service Facilities—Their Importance

The matter of service facilities in the furniture plant needs careful consideration if the most profitable operation is to be secured. With high-speed machines, frequent tool changes, runs of comparatively small lots, and the natural dusty condition of the average machine room, such matters as keeping motors and machines clean, belts in condition, and all transmission apparatus well oiled, assume an added importance.

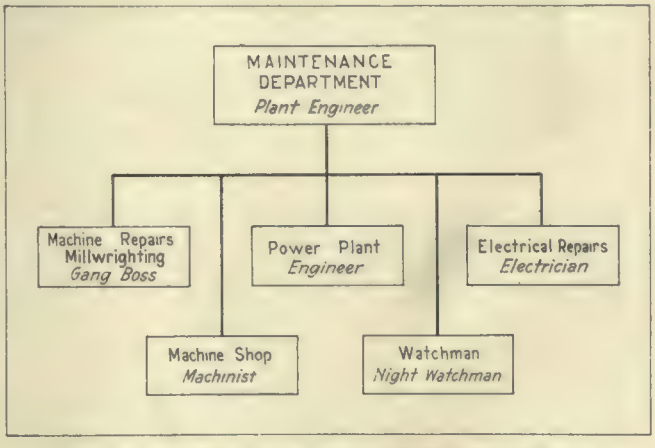


FIG. 3 MAINTENANCE DEPARTMENT ORGANIZATION

Of the lumber which is brought into the machine room from the dry kiln in the average southern plant, about 40 per cent is waste. A limited amount of this waste is sold to employees as fire-wood, but the greater portion is burned in the boilers to generate power for the operation of the plant. With lumber costing $48 per 1000 bd. ft. and with a 40 per cent waste factor, we have a lumber cost of $67.20 per 1000 bd. ft. for the lumber that is actually used.

Despite the low cost of hydro-electric power in southern localities, very few furniture plants make use of this power for the operation of their plants, as there is no other means for disposal of the waste from cutting-up operations. Some larger concerns have undertaken the production of small wood specialties which turn this waste into more profitable uses, but with the majority it is used for power generation only.

Belts and belting troubles furnish some of the most costly delays in the average plant. Common practice is for each operator to care for the belts of his machine. As is always the case where this practice is followed it results in:

1. Shorter life for belts.
2. More frequent stopping of machines.
3. Failure to correct the cause of belt trouble.

Assigning one man from the maintenance department to have charge of the repair and upkeep of all belts throughout the plant, and providing him with proper equipment and adequate facilities for doing his work, has resulted in elimination of the following belt troubles:

1. Belts coming apart at laps—due to belts being run in the wrong direction.
2. Belts running crooked on pulleys—due to improper lacing, pulleys being out of line, laced by careless workmen, motor shifting out of line.
3. Belts jumping off the pulleys—due to being laced too loose, shafting out of line, overloading, too narrow or too light a belt for the purpose, excessive use of belt dressing.
4. Excessive stretch—due to using belts too light for the work, cutting belt too long when installing.
5. Belts destroyed in operation—due to rough pulleys, wood pulleys splintering, nails in pulleys.
6. Belts cutting on edges—due to pulleys being out of line, belts rubbing on projecting parts, shifter fingers worn and shifter mechanism defective.

In a plant employing but 200 workers, the introduction of better methods of belt maintenance resulted in savings in excess of $2000 per year, by giving attention to these details of service, to say nothing of increased output because machines were kept in operation.

To control the activities of the maintenance department it has been necessary to place all the activities of this department under one person, who, for convenience, is termed the "plant engineer." The maintenance department of a plant employing 240 workers is shown in Fig. 3. In all cases the section heads are "working foremen" who are responsible directly to the plant engineer, who in turn is responsible to the factory manager.

Among the functions for which the plant engineer is responsible are the following:

1. Furnishing light, heat, power, compressed air, hot and cold water, steam, ventilation, sewerage and fire protection.
2. For all elevator and janitor service.
3. For all millwrighting, repairs to and installation of machinery, and for all moving of machinery and equipment.
4. The maintenance of all belting; also for oiling and care of all transmission equipment.
5. Installing, altering and repairing all electrical equipment and apparatus throughout the plant.
6. The inspection of all machinery and equipment at stated intervals and its repair before a breakdown actually occurs, when possible.
7. The production of all special tools, cutters, bits, etc., when such tools cannot be purchased outside at a less cost than they can be made for in the plant.
8. All sweeping and cleaning inside and outside the plant.
9. All necessary watchman service for the company's property and for all records regarding such service.
10. Executing all plant orders received from foremen of the several departments, with promptness and dispatch, in order that there may be a minimum delay in production.

Industry Moves Toward Simplification

PAINT and varnish brush makers, distributors and users on May 22 adopted a program eliminating 342 of the 480 sizes of those commodities now made. Hardware retailers, master painters and others endorsed the program.

Boxed elastic webbing was reduced from 11 widths to 7, and rubber sizes used in this product from 8 to 3 by vote of a general conference held in the Department of Commerce on May 22. This program was fully endorsed by department and dry goods stores.

Reduction in sizes and brands of grocery paper bags from 6280 to 4700 was adopted by a general conference on May 26. Standards of cubical contents for bags of nominal sizes have been presented to the Bureau of Standards for approval.

Formal acceptance of the standard inquiry, purchase order and invoice forms has been received from more than 20 trade associations, 32 railroads and 95 individual companies.

Ten thousand copies of recommendations of manufacturers as to simplified thicknesses of box board, set up and folding boxes have been sent to members of 35 national shipper organizations as a preliminary to final conference action.

Existing variations of size of wood office desks and tables are being surveyed, a committee of manufacturers, office executives, distributors and others having begun work on June 2.

Reduction of the existing variety of tire sizes is favored by 12 makers of passenger automobiles, 5 automobile clubs, 12 manufacturers of motor trucks, 34 pneumatic tire makers, 5 wheel and rim manufacturers, and 53 other manufacturers of chains, covers, repair molds, rim tools, etc.

Methods of 42 Manufacturers in Distributing Expenses to Product

Selling and Administrative Expenses Handled in Four Ways

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THIS paper gives the results of a survey of 42 of the leading industries of Pittsburgh. The study was made under the direction of the National Association of Cost Accountants for the sole purpose of finding the actual practice that was being followed in the distribution of selling and administrative expenses to the units or divisions of product.

The 42 industries are both diversified and quite representative of the industrial life of Pittsburgh. The list covers many items, from cork to glass, to pig iron, to pickles. The firms assisting in this survey include such well-known industries as The Allegheny Steel Company, The United Engineering Company, The Oliver Iron and Steel Company, The National Glass Company, The National Radiator Company, The Heinz Company, The Byers Pipe Company, The Pittsburgh Valve Foundry and Construction Company, The Westinghouse Electric and Manufacturing Company, et al.

Both large and small firms were surveyed. For instance, the smallest plant showed the following annual distribution of expenses:

Manufacturing costs	$1,350,000
Selling expense	40,000
Administrative expense	55,000
	$1,445,000

In contrast, the largest industry reporting showed annual costs and expenses totaling over $200,000,000. It should also be stated in this connection that both job and process cost systems are represented in this survey. In fact, many of the industries are so large that they have both job and process systems in the different divisions of their plant.

No Uniform Practice

As different plants were visited it became apparent that there was no uniformity of practice in method of distributing the selling and administrative expenses to product, and, what is of greater importance, there was found no uniformity whatsoever as to what expenses should be placed under selling and administration.

To illustrate: In one large concern "administrative expenses" means expenses incurred in performing general administrative functions, and includes executive salaries, general office expenses, office supplies, telephone and telegram, legal expenses, traveling expenses, and office furniture and fixtures. Donations, corporate taxes, pensions, bond discounts and fire losses (not covered by insurance), as well as many other items difficult of classification, are closed into an account called "non-departmental costs." This leaves the administrative account localized in its scope to those expenses of administrative officers in carrying on the firm's affairs.

Another concern, just the reverse of the above, uses "general administrative expenses" as a "billy-goat" account that swallows about everything that is not definitely charged to manufacturing or selling.

This lack of uniformity as to meaning and scope of nomenclature suggested the need for a separate study as to the frequency with which different items of expenditure are placed in the two general accounts—selling and administration. This separate survey is now under way and covers the practice of over 200 firms.

I mention this lack of uniformity as indication of the need for serious study and standardization in accounting nomenclature. The non-standardized practices now in use in no way affected the results shown in this paper, which concerned itself primarily with the *how* and *why* of charging selling and administrative expenses to product, as used by the firms studied.

The methods of distribution found in the 42 different industries fall into four distinct groups or classifications. The terms that I have applied to these groups and the number of firms in each are as follows:

	Number of Firms
Group A. Do little or nothing	17
Group B. General ratio method	20
Group C. Budget and effort method	4
Group D. Special method	1

In taking up each group in detail and in portraying the practices found, I have attempted to give the methods and reasons exactly as reported by the specific firm in question.

Group A: Do Little or Nothing

Of the 42 industries, 17 make little or no attempt to have their selling or general administrative expenses applied to divisions of product or to production departments. The fact that they do not do so must not

be turned forthwith into an adverse criticism of their accounting methods. The following points of view, taken from some of the firms in this grouping, give explanations that carry considerable defense for their practices.

Take as an illustration a certain manufacturer of miscellaneous steel parts under a process system. This firm produces some 700 different commodities. Quoting: "We make no attempt to distribute selling and general administrative expenses to our product. (1) We know that these expenses never exceed 6 per cent of the total costs; therefore their importance is not great. (2) We have a very small but very busy accounting department and I can see no benefits coming from placing extra effort in distributing administrative and selling expenses. (3) We have such a large number of commodities going through such a variety of processes that any distribution would be based pretty much upon guesswork. This is particularly true of the administrative items. (4) Our salesmen sell our firm and its high-grade products and are not concerned with any of the specific lines."

Other Cases Where No Distribution Is Made

Another concern working under a process system and making no distribution to specific products gives the following reasons. One can readily see that their procedure is wholly justifiable. They call particular attention to the selling expenses. Quoting: "If we were to attempt to work selling expenses back into the cost of manufacture, the question at once arises as to whether we should work such expense back with finished product, or still further back into processes preceding the finished product. Even if we would stop with finished product, it would not be true of general administration, because they are just as applicable to intermediate processes. When you consider that our shipments at certain times are heavy and production light, while at other times the reverse is true, you appreciate the complications that would arise. Again, our sales force, to a great extent, is engaged in missionary work or general work and not in securing specific orders, and certainly not in selling to ultimate consumers. We sell as many as a hundred different kinds of standard products to a single jobber. Charging selling and administrative expenses into costs might not be considered inventory inflation but nevertheless we consider it much more conservative from both an accounting and a financial viewpoint to deduct the specific expenses incurred each month and dispose of them through selling, administrative and profit and loss accounts rather than to carry them in the inventories (as accumulated costs)."

The following reason for not distributing selling and administrative expenses given by one of the smaller firms will also be of interest. Quoting: "When our accounting system was installed by the X accounting firm five years ago, they made no provision for the distribution of our selling and administrative expenses to the different products. Although many of us feel that such a distribution is advisable at the present, yet our executive department looks upon it with disfavor. He (the president) has not forgotten how the installation of the present system upset our routine work, making more or less trouble."

From an analysis of the 17 companies comprising group A, we are safe in holding that most of those who do not distribute the expenses of selling and general administration to product base their non-action on the principle that the cost and bother involved would offset any advantages. As one concern very clearly pointed out: "But three per cent of our total costs and expenses is expended for selling, and less than two per cent for general administration. Our different products are very numerous, our selling is so greatly diversified and our general administration so far removed from any product or department, that any method of distribution would have to be based upon the most arbitrary of principles."

Another illustration presents a somewhat different view. It comes from a very large concern. "We use what might be termed average selling and administrative expenses which are constantly compared with production costs, but we make no attempt to allocate these general expenses to the many units of product sold. Probably a goodly share of the selling expenses, 30 per cent, and perhaps 10 per cent of the administrative expenses could be charged to specific products and with considerable justice. In such an allocation, however, there always lurk so many factors that make for error that we believe our present method of doing nothing is less erroneous and certainly less expensive than some regular distribution method."

The above points give the main and outstanding views of those who make no detailed distributions.

Group B: General Ratios Applied to Specific Commodities

The general practice that characterizes 20 of the industries surveyed is summed up in the following general method: Find the ratio that total selling expenses and total general administrative expenses bear to total manufacturing costs; apply these percentage ratios to production costs of the specific commodities, processes, or departments. An illustration taken from a highly specialized steel concern will explain the method.

During the year 1924 the total manufacturing costs were $1,624,836. The total selling and administrative costs were $235,629. Thus the ratio shows that for every dollar of production costs, 15 cents should be charged for selling and administrative expenses.

The factory costs of a specific order were:

Direct labor	$52.00
Material	150.00
Overhead	15.60
Total	$217.60
Applying 15 per cent to cover selling and general administrative expenses	32.64
Total cost	$250.24

Another firm making only one kind of product but

at three different plants finds the total selling and administrative expense and reduces it to poundage of product. The selling and administrative expenses are then charged to the different plants on the basis of the production of each. Making but one commodity, no further distribution is needed.

Again in a large steel company making bolts, nuts, screws, hooks, etc., entirely under a process cost system, the total selling and administrative expenses are divided by the total direct labor hours of all processes. The amount of selling and administrative expense for each process is thus dependent upon the direct labor hours in that process.

No Relation of Direct Labor to Selling Expense

This rule-of-thumb method easily takes care of the bookkeeping, and therefore the firm is satisfied with its success. However, it was found that the direct labor involved in the different processes had no relation to the selling expenses of the different processes and commodities while the administrative expenses had but the slightest relationship. The only justification given by their auditor was: "The reason for this method is that the longer time consumed in manufacturing any product the greater proportion it should bear of the cost of the general administrative and of the selling expenses. This method has always given us a satisfactory distribution and I doubt if a change would give a more correct result to warrant the change. In all probability there would be some differences in the share of these expenses that would be carried by certain of our processes but such difference would not be sufficiently great to offset the trouble in making the detailed distributions." This auditor, however, admitted his uncertainty as to what a more detailed distribution might show and agreed that the subject was of such importance in his firm that upon first opportunity a specific study of the problem would be made.

One more firm within this group is a large foundry. So large is this foundry in the iron and steel industry that its system is used as a model, and has been adopted as a uniform system for a great number of foundries throughout the United States.

Their method is: A monthly summary of the production costs of good castings is sent from each of their plants to the general offices. To these costs are added the selling and administrative expenses, allocated to the several plants on the normal rated capacity of each. This rated capacity is used as a numerator, the capacity of all plants as the denominator. This fraction for each plant represents the portion of selling and administration that it must carry. The actual production costs of castings shipped plus the share of selling and general administration based upon the normal standard rating give the total costs. Dividing this by the pounds shipped gives a total cost per pound, which is then applied to specific castings.

The following method found in a large engineering and foundry corporation is another variety of the general ratio principle: The selling and administrative expenses are charged to units of product at a given per cent (now 6 per cent of the total plant cost of each job). The per cent is arbitrarily determined upon from time to time at that point which seems reasonable. It is determined by experience over a period of time. This present practice is followed because it is easily applied, and consideration of additional factors would introduce complications. Furthermore, it is doubtful whether any other system would produce results more accurate than the existing method. The very nature of the business makes it difficult to find the cost of administration on any given job, for no two are alike. No change seems desirable as the present one works out all right. After all, the business is one in which there can be little standardization. Direct labor, rent, interest on investment, and raw materials are costed scientifically, and then such other items as selling expense and administrative expense are added as the case seems to justify—at present 6 per cent.

Other methods of distributing selling and administrative expenses to production on the general ratio principle might be cited, but enough has been given to show the common method in the Pittsburgh District.

For emphasis, these conditions should be noted:

1. It represents the largest practice of distributing selling and general administrative expenses found in the industries covered by this survey.
2. Only to a slight extent do the general ratios used agree with amounts that should have been carried by a given unit of production or specific process.
3. Those charged with the administration of the accounting system and to a large extent responsible for the methods in vogue, are quite satisfied with the principle of applying general ratios to specific commodities, because of its bookkeeping ease and its low cost of operation.
4. In applying the ratio method, one firm called attention to the need of taking material costs away from total manufacturing costs before calculating the ratio that should be used for distributing administrative costs. His reasoning was based on the fact that the administrative function was centered upon the problems of labor and overhead and in no way upon raw material costs.

It would be grossly unfair for us to hold that the general ratio method was defective *per se*, or that it was not scientifically correct where complete standardization of product was existing. But we can hold that in those industries surveyed its justification for being in existence was based upon the ease and simplicity of its application rather than upon its scientific soundness. One pertinently and persistently meets the statement: "It is about the best and simplest method in sight, and what better way is there that is within the realm of fair cost of operation?"

Group C: Budget and Effort Methods

Under this group are presented several methods of distributing selling and administration that portray a decided step forward in an attempt to establish a more scientific way of distribution than was afforded by

the general ratio method just described. I believe there is no better way of placing the principles of these newer methods than by describing the practices of the firms which have developed them.

A certain large concern has developed the principle of applying selling and administrative expenses to specific lines of product on the basis of the effort expended by the selling and administrative forces to the specific lines. A large portion of their selling expenses are first distributed direct to the specific lines of product. A careful analysis makes this possible. Such expenses as advertising, exhibits, publicity and catalogs are to a considerable extent so analyzed and charged. Such portion of the above expenses, however, as is not directly chargeable, also such remaining expenses as district selling expense, warehouse expense, etc., are distributed to specific lines of product on schedules prepared by the sales department. The basis for these schedules is the estimated cost of effort expended to sell the various lines of product. This distribution of effort is determined by a three-man committee made up of a representative of the engineering and manufacturing department, the sales department, and the accounting department. This firm runs about 80 per cent standard product, which to a great extent sells itself, and requires little general administration. The "exception principle" of management is manifest in this plant, i.e., the general administrative officers and the selling forces are concerned to a large degree with the irregular special orders and the development of new lines. The effort principle thus heavily charges new lines and special jobs and orders while standard products carry a light load.

At first blush this method appears highly arbitrary, but upon further study it has much merit. The following are pointed out as its attractive features:

1. It makes each general administrator, from the president down, analyze his work and distribute it to different lines, subject to the control of the committee of three.
2. These distributions are surveyed and often changed by a committee composed of men who represent the three divergent fields of the business, i.e., finance, selling, and production.
3. It removes much of the criticism characteristic of the former methods which made no attempt at scientific analyses.
4. It is flexible, is subject to constant correction, and is as near an ideal method as can be reached under present conditions and circumstances.
5. The accounting department places considerable of the selling and administrative expenses direct to the specific products before the residue is placed before the committee for allocation on the basis of effort involved.

A glass manufacturing concern turning out several distinct lines of product such as plate glass, bottle glass, window glass, etc., has inaugurated this year (1925) a system of distributing selling and administrative expenses that is unique.

The monthly distribution of administrative expense is made on the basis of proportionate sales, plus the inventory of each line of product. By combining sales and inventory they eliminate the unevenness that occurs when one line is selling faster than another, although the latter is not falling off in production. This ratio, however, is not the final one used. It is adjusted to take care of any features that should be considered as effecting a fair distribution to individual lines. The adjustment is under the jurisdiction of the auditor, general manager and president of the concern.

The selling expenses are distributed in practically the same manner except that a large proportion of the expense is charged direct. The volume of sales of each line is used in finding the ratio of distribution to specific lines of the residue. A committee made up of the sales manager, auditor and president set the adjustments that are to take care of special conditions. The outstanding feature of this method is the establishment of a committee that adjusts general ratios so as to meet the conditions that arise and make for differences in specific cases.

A rather large concern having seven different plants which produce a different commodity in each plant constructs both a selling and an administrative budget allotment which is allocated to the seven plants at the beginning of the year. The basis of distribution is made up according to normal costs shown through past experience. As far as possible it is based upon a careful analysis of the proportionate time spent by the general selling and administrative departments upon each plant or product. These budgets are credited out and charged to each plant output as actual production takes place. The administrative expense is charged as the goods are placed in the warehouses—the selling expenses only upon shipments, as they are made. At the end of the year the over- or under-absorption of the selling and administrative expenses is thrown into general profit and loss. The ease of this method is due entirely to each plant producing a specific product. As only seven divisions of the selling and administrative expenses are made, an estimated budget is not difficult to erect.

As was pointed out before, an analysis of each of these methods indicates an attempt at least to distribute the selling and administrative expenses to production, upon a scientific basis. At the same time, each one also attempts to keep such distribution methods as simplified as possible.

One lone plant had a method that was decidedly peculiar. It distributed the administrative expenses over the manufacturing and the selling divisions. Such distribution was based upon the comparative salary pay-rolls of the two divisions. No distribution whatsoever was made of selling costs to manufacturing. When the auditor was interrogated as to why this special method was used, he placed it entirely upon the inertia of tradition. When asked what he thought of it, there came the brusque answer: "Rotten!"

A summary of the 42 plants investigated shows the following conditions existing, regarding the distribution of selling and administrative expenses to production:

1. Seventeen firms practically do nothing in the way

of distributing selling or administrative expenses to specific products or processes. Some point out clearly the impossibility of making such distributions. Others claim that it is possible but not advisable, while a few desire to make such distributions, but circumstances over which they have no control prohibit any distributions.

2. Twenty firms distribute their selling and administrative expenses to specific products, using the ratio that total production cost bears to total selling and total administration. Of these 20 firms, seven use the total production costs, nine the direct labor dollar, and one the direct labor hour and one the poundage for distribution to specific products.

This general ratio method is the common method of distribution and is rather indicative of how the distribution is made in a considerable portion of other industries in the Pittsburgh District. Time and again the attention of the author was called to the method used by kindred plants to distribute their selling and administrative expenses, and to the fact that the plant in question simply imitated the methods of these other firms.

3. Four firms have developed or are developing the distribution of selling and administrative expenses on the basis of analyses as to the amounts each product and process should carry. Effort and time expended on the different lines of product have been used as a basis for distributing a residue left after as much of the expenses as possible are charged direct to the product.

These attempts are on the vanguard. Truly they have developed no absolute or exact method, but by the use of committee or group judgments applied to residue portions of the total expenses, they approach about as near exactness as is possible.

The question asked of each of these systems was: "Does it pay?" The answer in each case was: "Yes, or we wouldn't use it." They have without doubt made very definite studies in keeping their methods as simple as possible.

4. Then one firm reported a very odd system of distribution that goes begging for the justification of its existence.

A study of this sort would fail in its mission if the results of the research did not point both advantages and disadvantages of distribution methods; and what is more important, if it did not evolve the underlying principles that must be applied when the distribution of selling and administration expenses is being considered.

Advantages of Specific Distribution

The following advantages result from a specific distribution of selling and general administrative expenses to different items of production:

1. Net profit or loss on each kind of product can be determined rather than simply the manufacturing costs of each product.
   This advantage has many corollaries, among which these are of immediate importance:
   (a) Concentration on profitable products is possible.
   (b) Unprofitable products can be analyzed, not only as to manufacturing costs but also as to sales and administration.
   (c) It may readily show that a *laissez-faire* policy (do-nothing attitude) may mean erroneous conclusions.
2. Setting of selling prices on a net profit basis made possible, unless competition governs, "net profit" meaning that selling and administrative costs have been met by the sales.
3. The specific studies necessary to distribute these expenses scientifically have certain good results.
   (a) Job analysis of administrative and selling positions.
   (b) Budget controls established.
4. Elimination of friction among production, selling and administrative departments through the use of a committee system.
5. Cost accounting comes into its own by broadening its scope to include all costs, and does not stop at the door of the manufacturing department.

Disadvantages of Detailed Distribution

Against these advantages must be placed such serious obstacles as come with detailed distribution. It does mean more clerical work, and it does mean that there still remain arbitrary distributions. The good that comes from the detailed distributions must offset all the extra clerical costs, and it must be both sufficiently accurate and useful to justify the extra costs that it obviously necessitates.

Principles in Specific Distributions

If any detailed distribution is contemplated whereby selling and administrative expenses are to be allocated to units or lines of production, certain fundamental principles must be considered. These principles developed as the research work of this survey proceeded.

It is believed that their application can well be used to determine the final advisability of attempting to distribute selling and administrative expenses to detail products. These principles are:

1. Even if a distribution can be made to either specific processes or products, there must be a practical net benefit that should govern the adoption.

In many of the firms visited the statement was often made, which in effect holds that a distribution to detail was possible but unprofitable. Both the expense of compilation and the small advantage after compilation has been completed debar the incorporation of the plan. In short, any method of detail distribution must be so simple and easy of operation that it readily can show a real profitable advantage for its adoption.

2. In the determination of rates of distribution to specific products, normal rates for departments, processes and specific products should be determined as contrasted with the application of actual rates as they happen from month to month. By "normal rate" is meant the rate which indicates a general average con-

dition covering a long period of time. Thus it is the rate about which the actual rates tend to fluctuate, but seldom or never does the actual agree with the normal rate.

The normal rate carries much merit, in that it is not subject to short periodic changes, but rather indicates the general relationship that exists between administration, selling and production.

3. Such selling and administrative expenses as can be directly and specifically distributed to the products should be cleared first. In some plants this direct distribution will absorb a very large portion of the administrative and selling expenses, thus leaving a comparatively small residue that must be distributed by some indirect method. Other firms, in contrast, will find that only a small part of their selling and administrative expenses will lend themselves as a direct charge to product. In these cases a heavy burden rests on equitably distributing the indirect portion.

4. The residue must be distributed on a more or less arbitrary basis. This arbitrary distribution, however, can be toned down to what amounts almost to scientific procedure. Group judgment so diversified in interest and occupation, applied to the distribution of that portion of the expenses not directly charged, will result in about as fair a distribution as is humanly possible.

Loading Hopper Increases Truck Efficiency

WHERE large quantities of materials such as coal, coke, ore, crushed stone and sand are to be handled from barge to cars or trucks, an overhead crane with extension boom is often installed. This crane, equipped with a bucket, elevates the material and dumps it into a hopper from which it is run into cars for transportation to storage or point of use.

Frequently the overhead hopper is mounted on uprights carrying wheels which run on a wide gage track, straddling the standard gage railroad track. The cars are spotted beneath the hopper for loading.

For small quantities of material such equipment involves too large an investment, but at the same time the idea points the way to an economical installation of a similar kind, which does away with the high cost of hand labor or semi-mechanical methods.

Fig. 1 illustrates the method formerly used to load copra, or ground coconut shells, at San Francisco docks. A truck was backed up near the barge and loaded by means of a tub or bucket carried on a hoist. The truck had to wait while successive buckets were filled, hoisted and dumped, and the hoist had to stop while a filled truck was replaced by an empty, which,

FIG. 1 OLD METHOD OF HANDLING COPRA WAS SLOW

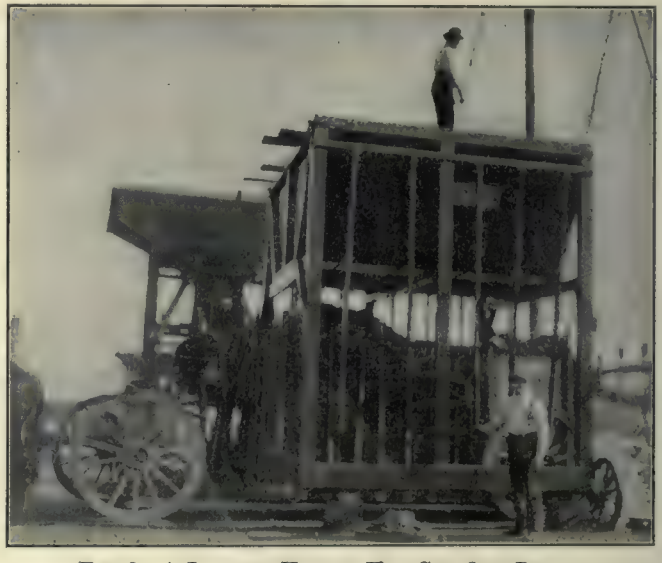


FIG. 2 A LOADING HOPPER HAS CUT OUT DELAY

meanwhile, had been idle several minutes. Hurried loading resulted in spillage of material.

A six-ton hopper, Fig. 2, was finally constructed to do away with all this delay. It is of simple construction and mounted on four wagon wheels, so that it can be moved to any point on the dock. The same bucket as before is used to raise the copra from the barges, but it operates continuously, whether or not a wagon is on hand, for it discharges into the hopper.

In the bottom of the hopper are 10 metal gates, opened by means of a long lever extending down within easy reach of the operator, as shown in photograph. Wagons are backed underneath the hopper, filled and driven away. Neither hoist nor wagons have to wait for each other.

This provision for continuous operation has increased the tonnage handled. The average rate by use of the hopper is now 30 loads of six-tons each per day, which is considerably greater than the previous record.

What Sales Executives Should Know

About Dangers of Misinterpreting Trade Association Statistics

By GILBERT H. MONTAGUE

Of the New York Bar

RECENT decisions of the United States Supreme Court in the Maple Flooring Manufacturers' Association and the Cement Manufacturers' Protective Association cases may result in greatly extended activities of these and similar organizations. But these decisions do not modify many others which have found certain practices to be in restraint of trade. Manufacturers should acquaint themselves with the true situation, as individuals and as members of their respective associations.

Since 1919 the Department of Justice and Federal Trade Commission have commenced nearly 1100 prosecutions under the Anti-Trust Laws and Federal Trade Commission Law, against upwards of 2000 American business concerns, and have instituted probably 2500 more investigations into the affairs of some 6000 more concerns upon complaints charging alleged violations of these laws.

These cover a wide range of business transactions. Within the danger zone of government prosecution are the following activities, mainly in the work of the sales department, which should be handled with due precaution:

Correspondence within the sales organization, or with the trade regarding "price cutting."
"Moral suasion" regarding resale prices.
Pressure from dealers to correct "price cutting."
"Co-operation" between salesmen and dealers to correct "price cutting."
"Refusals to sell."
"Guarantee against decline in prices."
"Cancellation."
"Basing point" prices.
"Special sales" offers.
"Wholesale discounts" and "retail discounts."
"Classification" of "wholesalers" and "retailers."
"Quantity discounts."
"Differential discounts."
"Cumulative discounts."
"Rebates" to customers.
"Classification" of "irregular dealers" or "illegitimate dealers."
"Classification" of "buying clubs" or "co-operatives."
"Classification" of "chain stores."
"Classification" of "mail order houses."
"Co-operation" with dealers' associations.
"Purchases at excessive prices."
Acquisition of competitors' plants.
Acquisition of competitors' capital stock.
"Fictitious" or "excessive" price markings.
"Sales below cost."
"Combination sales" and "combination offers."
"Free deals."
"Premiums" and "prizes."
"Long term" sales contracts.
"Large quantity" sales contracts.
"Restrictions" on goods sold, leased, licensed or loaned.
"Exclusive dealers' agreements."
"Territorial restrictions."
"Consignment agreements."
"Misnomers" in corporate names or trade-names.
"Plagiarism" in corporate names, trade-names and trade-marks.
"Plagiarism" in advertising.
Inaccurate or disputed advertising.
"Free advertising."
Discrimination in sale of "advertising space."
Discrimination in "advertising rates."
Insufficient or disputed labels.
Inaccurate or disputed claims of quality.
"Buyers' entertainment."
"Hidden demonstrators."
"Compensation" to dealers' salesmen.
Patent license "restrictions."
Excessive claims of patent rights or trade-mark rights.
Guarantee against "law suits" or "expenses of litigation."
"Consent decrees" in patent and trade-mark infringement suits.
Insufficient identification of subsidiaries.
"Export price agreements" (under the Webb Export Trade Act).
"Export territorial agreements" (under the Webb Export Trade Act).
Association "standardization" work.
Association "statistical" work.
Association "credit and information" work.
Association "cost accounting" work.
Association "uniform contracts."
Association "uniform terms of sale."
Association "uniform allowances on 'trade-ins.'"
Pressure from dealers' associations.

This article was written at the request of the editors to point out certain dangers which must be safeguarded by the sales department and to aid in understanding recent trade association decisions. Mr. Montague and his organization have been counsel to many leading corporations on legal questions of marketing, advertising, unfair competition, and anti-trust problems. Many proceedings in which he has acted before the courts, Federal Trade Commission and Department of Justice have established leading precedents.

Ever-extending interpretations have been, and are

now being, applied by the Department of Justice and Federal Trade Commission. They may or may not be correct, but until that remote date when they are finally passed upon by the courts, any business concern which does not conform to these interpretations may, upon complaint to the Department of Justice or the Federal Trade Commission from any competitor or customer, be forced to defend itself against an ugly-sounding proceeding, prosecuted with all the authority of the United States, and be compelled for several years to incur the annoyance and expense which such a contest involves.

Precautions Which Avoid Trouble

All these inconveniences can be avoided if reasonable precautions are taken in advance. Every sales executive, therefore, ought to be kept promptly, continually and constructively advised, not only concerning the interpretations at present being applied but also concerning their probable future trend, both as regards activities carried on by his own sales organization, and also those of his competitors. This advice, to be thoroughly practical, should be in such form as to be directly applicable. Sometimes, when a sales organization is suffering from a competitor's aggressive tactics, which are flagrantly in violation of the law as interpreted by the Department of Justice or the Federal Trade Commission, he may desire to call this to his competitor's attention, or to lay it before some trade association, for action either within the association or through a "trade submittal" before the Federal Trade Commission or the Department of Commerce, or even to report it to the Department of Justice or the Federal Trade Commission.

In the Maple Flooring Manufacturers' Association case the government complained of:

1. The computation and distribution among the members of the association of the average cost to association members of all dimensions and grades of flooring.
2. The compilation and distribution among members of a booklet showing freight rates on flooring from Cadillac, Michigan, to between 5000 and 6000 points of shipment in the United States.
3. The gathering of statistics which at frequent intervals are supplied by each member of the Association to the secretary of the Association, giving complete information as to the quantity and kind of flooring sold and prices received by the reporting members, and the amount of stock on hand, which information is summarized by the secretary and transmitted to members without, however, revealing the identity of the members in connection with any specific information thus transmitted.
4. Meetings at which the representative members congregate and discuss the industry and exchange views as to its problems.

The decision of the Supreme Court was restricted to the issue of the right of trade associations to gather and disseminate certain information:

> We decide only that trade associations or combinations of persons or corporations which openly and fairly gather and disseminate information as to the cost of their product, the volume of production, the actual price which the product has brought in past transactions, stocks of merchandise on hand, approximate cost of transportation from the principal point of shipment to the points of consumption as did these defendants and who, as they did, meet and discuss such information and statistics without, however, reaching or attempting to reach any agreement or any concerted action with respect to prices or production or restraining competition, do not thereby engage in unlawful restraint of commerce.

The issue in the case of the Cement Manufacturers' Association was essentially the same, the government charging that the defendants controlled prices and production of cement:

1. By the use of "specific job contracts" for future delivery of cement, accompanied by a system of reports and trade espionage having as its objective the restriction of deliveries of cement under those contracts.
2. By compiling and distributing, among the members, freight rate books which give the rate of freight from arbitrary basing points to numerous points of delivery within the territorial area served by the several defendants.
3. By exchange of information concerning credits.
4. By activities of the Association at its meetings.

The opinion of the court referred to the Maple Flooring Manufacturers' Association decision, closing with:

> But here the government does not rely upon agreement or understanding and this record wholly fails to establish, either directly or by inference, any concerted action other than that involved in the gathering and dissemination of pertinent information with respect to the sale and distribution of cement to which we have referred, and it fails to show any effect on price and production except such as would naturally flow from the dissemination of that information in the trade and its natural influence on individual action.
>
> For reasons stated in United States *v.* Maple Flooring Association, supra, such activities are not in themselves unlawful restraints upon commerce and are not prohibited by the Sherman Act.

Collecting Trade Statistics Is Not Unlawful

Neither of these decisions, therefore, can be said to have broadly decided that the collecting and dissemination of trade statistics is necessarily and under all circumstances lawful. In both, the Supreme Court stressed the fact that both these associations were advised by legal counsel, and that by following such counsel's advice they on a number of occasions were prevented from wandering across the hairline which separates legality from illegality in this vexed subject of the anti-trust laws.

Throughout both of these decisions, the Supreme Court many times stated that it was only because of the particular facts of these cases, and the care with which these associations had conducted themselves, that their activities could be upheld as legal.

Worthington Tool Control Methods

Regulate Inspection, Accounting and Executive Supervision

By ANKER L. CHRISTENSEN

Engineer, Tool and Material Storage Department, Worthington Pump and Machinery Corporation

SINCE tools are so vitally important to efficient manufacturing, some plan for their inspection and supervision is an absolute necessity. The inspection service should be responsible for the functioning of the tool system and the physical condition of all the tools used in the factory.[1]

In planning an inspection system, every phase of the work should be considered. Frequent and systematic checks should be made to insure that:

1. The tool crib is kept in neat order.
2. The workmen are served with tools promptly.
3. The supply is kept up to the fixed quantities.
4. The tools are in good working condition.
5. Old and obsolete tools are promptly scrapped.
6. All rules and regulations pertaining to the tool system are carried out.
7. The tool system is co-operating with the other departments in the factory. In this connection it should be remembered that this is purely a service department whose duty is to facilitate manufacture.

All executives who are directly interested in production should make periodic inspection of the operations of the tool system. The works manager may simply check the cost of operating and the size of the tool inventory carried. He may also be interested in how it is co-operating with the other departments in carrying out the general policies of the company. Naturally his inspection of the physical lay-out would be at infrequent intervals—once a year being considered sufficient in many large factories.

The general superintendent is directly responsible for the efficient operation of the productive divisions of a factory. It is his duty to see that all loss of time due to lack of proper tools is reduced to a minimum, and that the tool system gives prompt and efficient service. For large factories, four inspections per year are suggested as sufficient.

The machine shop superintendent is particularly interested in having an ample supply of tools in good condition to meet all requirements. Consequently, he should make inspections more frequently—once or twice per month, depending on the size of the shop—and should cover the distributing system and the physical condition and serviceability of the tools.

In some large factories the procurement and maintenance of all equipment is centralized in one department. The head of this department is known as the equipment engineer. The tool system may be under his supervision and, if so, he should make an inspection every week to cover thoroughly service, condition and inventory of tools, methods of storing, issuing, keeping of records, etc.[2]

In other factories the tool system is under the supervision of a general storeskeeper. His duties would be identical with those given above. He may have an assistant who makes daily inspections, in which case his personal visits may be less frequent.

Routine of Tool Inspection

Responsibility for inspecting tools before they are put back in the bins should be carefully determined. Obviously, the greater part of this work must be done by the tool crib attendants. But there is a large amount of inspection work that they have neither the time nor the ability to do properly. There should be an expert tool inspector whose duty consists of a careful examination of:

1. New tools purchased.
2. New tools manufactured by company.
3. Tools returned to the crib after being used in the factory.
4. Tools in permanent possession of workmen.
5. Tools locked up at machines.
6. Tools and boxes sent out in the field on erection jobs.

New Tools, Purchased and Manufactured. Every tool whether purchased or manufactured should be inspected and checked back to the drawings to see that details are in accordance with the drawings and that hardened tools have the proper temper. Obviously, the product can be no more accurate than the tools that are used to fabricate it. A gage that is out of true by a few thousandths of an inch, if used in the finishing operation, may cause that entire job to be spoiled. Tools that are purchased from tool manufacturers are frequently not what the specifications call for. These should be inspected at the time of receiving and any that are not correct in every respect promptly rejected.

[1] See MANAGEMENT AND ADMINISTRATION, May 1925, pp. 467-470, June 1925, pp. 537-540, and July 1925, pp. 15-18, for previous articles on Worthington tool storage methods.

[2] See *Industrial Management*, January 1922, pp. 12-20, "How Tool Engineering Cuts Costs," by Joseph Lannen.

Tools Returned from the Shop. Each and every time a tool is returned to the crib from the shop, it should be thoroughly inspected. The volume of inspection is so great that it would be impracticable to have a tool inspector accomplish all this work. Tool crib attendants should be trained to do part of the inspecting while handling the tools. In each class of tools there are certain parts that should be examined carefully each time the tool is returned to the crib, and before it is placed in its bin. Standing orders have been worked out at the Worthington Works, giving specific instructions for inspecting each kind of tools. The orders have been so devised that all points are carefully covered in natural sequence in the operation of picking up a tool and returning it to the bin.

Special Tools for Machines. Tools that are used on one machine only should be kept in a cabinet by that machine, and inspected periodically to see that they are in the proper lockers and in good working order.

General and Special Tool Kits. These kits, when in possession of the workmen, should be inspected periodically and an endeavor made to prevent the men from accumulating a lot of odds and ends or obsolete tools.

Erection Department Tool Boxes. While the tool crib foreman is responsible for the quality and quantity of all tools put in the boxes when they are packed, as an extra precaution a check should be made by the tool inspector.

Fine Tools. There are many tools, such as instruments of precision, etc., which the tool crib attendants do not have the necessary knowledge or equipment to inspect. These should be sent to the tool repair room for checking and correcting after each issue to the shop.

Allocation of Cost

Proper allocation of cost is important in tool control, but it is not enough to know that a certain sum is charged to the tool account at the end of each month. Some classes of tools require a great deal of care and attention, and may absorb a majority of the tool upkeep of a factory. These particular groups should be studied carefully with a view to improvement in the existing tools or a change of design better to suit conditions.

The usual method of cost allocation of a tool system is about as follows:

1. *Labor.* This includes the wages of the foreman and the men working in the tool crib. While the tool inspector is not directly in control of the crib, his wages should be charged to the cost of operating the tool system.
2. *Supplies.* This item covers all the miscellaneous equipment and supplies that are to be used in the tool crib, such as paint, brushes, brooms, stationery, etc.
3. *Repairs and replacements.* The cost of tool up-keep may be divided into (a) repairs to the existing stock, and (b) replacement of worn out tools.

Such allocation is adequate for accounting purposes. The division of the small tool account to suit classes of tools is an aid to efficient tool control. If this division is used, however, it should not conflict with the regular accounting procedure in any way.

The repairs and maintenance of tools may be divided into two general divisions:

1. Major repairs and replacements for large and expensive tools.
2. Routine repair jobs, such as sharpening drills, checking gages, etc.

Major Repairs and Replacements. Repairs and replacements necessary for large and expensive tools, where the cost is considerable, should be made under individual order numbers. The item of expense may then be handled in the regular way by the cost department.

TABLE 6. SAMPLE PAGE OF SMALL TOOL ACCOUNT CLASSIFICATION

0250	Purchase or disbursement of countersinks
0251	R & R* of countersinks
0252	
0253	
0254	
0255	
0256	
0257	
0258	Making of countersinks when covered by appropriation
0259	
0260	Purchase or disbursement of reamers
0261	R & R of solid machine reamers
0262	R & R of solid hand reamers
0263	
0264	R & R of shell reamers
0265	
0266	
0267	
0268	Making reamers when covered by appropriation
0269	R & R of miscellaneous and special reamers
0270	Purchase or disbursement of taps
0271	R & R of standard machine taps
0272	R & R of standard hand taps
0273	
0274	
0275	R & R of inserted tooth taps, including pipe and valve seat
0276	
0277	
0278	Making of taps when covered by appropriation
0279	R & R of miscellaneous taps not otherwise covered
0280	Purchase or disbursement of air drills and parts
0281	R & R of all air drills
0282	
0283	
0284	R & R of electric drills
0285	
0286	
0287	
0288	
0289	
0290	Purchase or disbursement of D group tools not otherwise covered
0291	
0292	
0293	
0294	
0295	
0296	
0297	
0298	Making of boring tools on appropriation not otherwise covered
0299	R & R of all special tools which remove metal from the inside, that are not otherwise covered.

* R & R = repairs and replacement.

Routine Repair Jobs. In most factories there is a vast amount of repair work of a purely routine nature, such as sharpening drills, hardening cutting tools, checking gages, sharpening milling cutters, etc. It would be impractical to make a separate repair order for each tool. These minor charges may be handled by standing repair orders, into which all the charges for each group of tools may be collected and closed out to the regular tool account at the end of each month.

A block of order numbers to be used permanently as standing repair orders can be set aside. One method, which has been worked out and is now in satisfactory operation in the Worthington Works, is the use of numbers from 0000 to 0999, divided into blocks of 50 to 100 numbers and each block assigned to a general tool group.[3] The group blocks are then subdivided into sections of 10 numbers each (see Table 6). Each class of tools is assigned one of these sections, i.e., 0270-0279 is used for the maintenance and repair of taps, and individual numbers have been given to those sub-classes of tools used most in the factory. Thus, in Table 6, block 0272 is for repairs and replacements of standard hand taps.

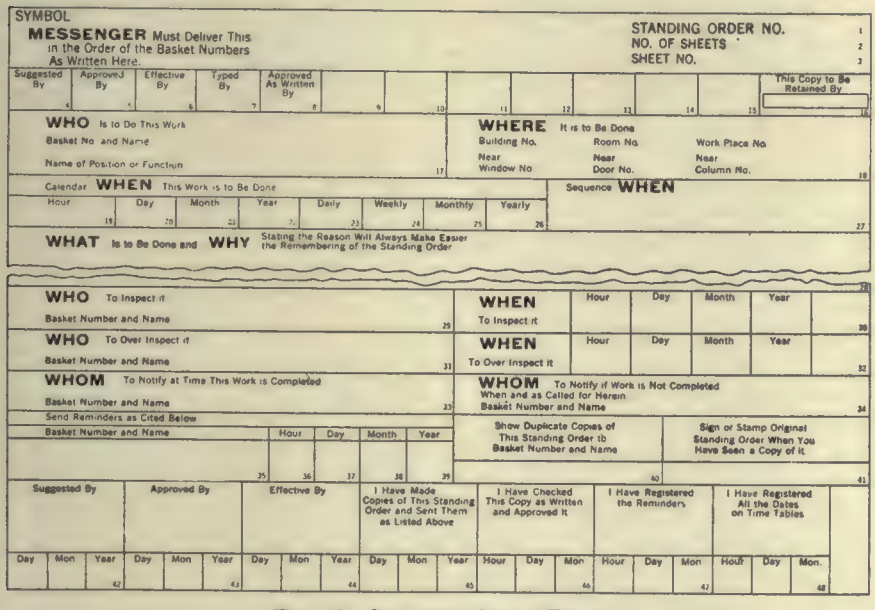

SYMBOL
MESSENGER Must Deliver This in the Order of the Basket Numbers As Written Here.
STANDING ORDER NO.
NO. OF SHEETS
SHEET NO.
Suggested By
Approved By
Effective By
Typed By
Approved As Written By
This Copy to Be Retained By
WHO Is to Do This Work
Basket No. and Name
Name of Position or Function
WHERE It is to Be Done
Building No.
Room No.
Work Place No.
Near Window No.
Near Door No.
Near Column No.
Calendar WHEN This Work is to Be Done
Hour
Day
Month
Year
Daily
Weekly
Monthly
Yearly
Sequence WHEN
WHAT Is to Be Done and WHY Stating the Reason Will Always Make Easier the Remembering of the Standing Order
WHO To Inspect It
Basket Number and Name
WHEN To Inspect It
WHO To Over Inspect It
WHEN To Over Inspect It
WHOM To Notify at Time This Work is Completed
WHOM To Notify if Work is Not Completed When and as Called for Herein
Send Reminders as Cited Below
Show Duplicate Copies of This Standing Order to Basket Number and Name
Sign or Stamp Original Standing Order When You Have Been a Copy of It
I Have Made Copies of This Standing Order and Sent Them as Listed Above
I Have Checked This Copy as Written and Approved It
I Have Registered the Reminders
I Have Registered All the Dates on Time Tables

FIG. 12 STANDING ORDER FORM

Printed on a standard 8½ × 11 in. sheet. Space No. 28 and spaces 35-41, inclusive, can be made relatively higher than shown to allow ample room for entries.

In order that outside purchases and shop manufactures may be kept separate, for purposes of comparison, the first number in each sub-class of standing orders is assigned to the purchase of that class of tools; thus, 0260 covers the purchase of reamers.

The last number of each sub-class is assigned in each case to miscellaneous repairs and replacements not otherwise covered, in order to keep the number of standing repair orders down to a practical working basis. Should this miscellaneous account become too large at any time, an investigation may be made and any tools that need closer attention may be assigned other numbers. Vacancies are left in the classification for each group for that purpose.

Table 6 gives one page of a detailed classification of the small tool account. In case the accounting department of a factory uses sorting and tabulating machines—like the Powers or Hollerith systems—and no other provisions have been made, the standing tool repair order may be punched in any of the columns, such as weight or miscellaneous. This will not interfere with the regular punching, as no weights or other figures used are apt to have zero for their first digit. As will be noted, every standing order for tool repairs has four digits—the first of each being zero.

[3] See MANAGEMENT AND ADMINISTRATION for May 1925, p. 469, Table 4, Key Sheet for Mnemonic Classification of Tools.

Executive Control

Many orders, both oral and written, may be necessary to make tool service a real aid to production. The former usually cover temporary emergencies; but the latter partake of a permanent nature and are called standing orders or general instructions. These standing orders should be as clear, concise, and complete as it is possible to make them. The five essential points, or W's, of issuing an order are:

1. What is to be done.
2. Where it is to be done.
3. When it is to be done.
4. Who is to do it.
5. Why it is to be done.

What Is to Be Done. The method of performance, the nature of work and the material to be used should be clearly indicated. Instructions should not impose impossible and absurd conditions nor conflict with existing orders.

Where the Work Is to Be Done. Much confusion and trouble can be avoided if the orders state specifically and precisely just where the work is to be performed.

When the Work Is to Be Done. In some cases the time element, or performance, is contingent upon certain conditions, or a sequence which cannot be changed.

Who Is to Perform the Work. Work should be assigned to one individual, or stated in such a manner that there can be no question as to who is responsible for its performance.

Why Is the Work to Be Done. A clear statement not only fixes the idea in the mind of the worker, but also enlists his intelligent co-operation. It gives him a feeling of confidence in his accomplishment.

Orders should be written in some standard form with the main points to be considered, i.e., the five W's, always arranged in the same sequence. For this purpose standing order form, Fig. 12, has been devised.

After general orders have been issued by persons in authority, adequate provision must be made for carrying them out. This may be termed the inspection or follow-up function. As a general rule, the person who has the authority to issue an order and make it effective should be responsible for seeing that it is carried out.

The standing order form in Fig. 12 states definitely who is to inspect the work and check up all the instructions headed on the form, and also who is to over-inspect the work and be notified if it is not done. It therefore accomplishes the two things necessary in making orders effective: (1) Issuing the order; (2) seeing that the order is properly carried out.

(To be continued in the September issue.)

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 100 magazines; it also includes the publications of some 50 book publishers and professional societies so far as these are of managerial interest to manufacturing executives. The number at the right of each item is the index symbol according to the Dewey Decimal Classification System. If articles are clipped and filed according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. The books and pamphlets indexed can be procured from the Management Publication Corporation or from their respective publishers. Photostat copies (white printing on black background) of any magazine article indexed can be obtained at a *price of 25 cents the page*, by addressing the Engineering Societies Library, 29 West 39th Street, New York City. Remittance must accompany the order. When ordering photostats please quote from the index: (1) Title of article; (2) Index number; (3) Name, date, and page numbers of periodical in which the item appears. The editors will be glad to furnish on request additional information in regard to industrial buildings and equipment, and the management of manufacturing industries.

Industrial Buildings and Plant Maintenance

Buildings and Equipment

Arc Welded Steel Building. 658.22
A. G. Bissel. *Welding Engineer*, May 1925, pp. 17-20. Illus. Welding not only cuts cost of fabrication, but also makes possible use of discarded materials.

Building for Industrial Research and Testing Work. 658.23
Engineering News-Record, June 25, 1925, pp. 1056-1058. Illus. Description of the design and construction of the new building of the White Motor Co. devoted to industrial research and experimental testing of materials and mechanism.

Concrete in Industrial Buildings. 658.22
W. E. Hart. MANAGEMENT AND ADMINISTRATION, July 1925, pp. 29-32. Illus. Discussion of concrete as a building material from the standpoint of first cost, maintenance, depreciation, fire and earthquake resistance, comfort, strength, adaptability and freedom from vibration.

Getting the Long-Time Dividend from Factory Windows. 658.241
K. D. Hamilton. *Factory*, July 1925, pp. 42-46, 82, 83, 84. Illus. Methods of maintaining window areas in industrial plants, to secure maximum effectiveness, based on the experience of the Geo. E. Keith Co.

Magnesite Floor in Industry. 658.22
Harold B. Kilmer. *Industrial Management*, June 1925, pp. 368-371. Illus. Its characteristics and properties, sub-flooring, protection, cost and maintenance.

Modern Freight Car Repair Shop. 658.2
James M. Plaskitt. *Railway Mechanical Engineer*, June 1925, pp. 333-341. Illus. Layout of plant and routing of materials to facilitate production in the new Finley shops of the Southern Railway System. Administration, employee co-operation.

Removing Dust Produced in Industrial Plants. 658.382
Charles L. Hubbard. *Industrial Engineer*, July 1925, pp. 320-326, 355-356. Illus. Equipment and methods used; effects of dust on men and machines and its relation to fire hazard.

Time Is Best Test of Industrial Plant Design. 658.23
Iron Trade Review, June 18, 1925, pp. 1567-1571. Plant layout, and material handling and storage features of the Consolidated Press division of E. W. Bliss Co. demonstrate efficiency through 10 years of service.

28 Cases Where Good Lighting Paid. 658.24
Russell J. Waldo. MANAGEMENT AND ADMINISTRATION, August 1925, pp. 63-66. Illus. Correct windows, glass, blinds, white paint, and proper lamps and reflectors increase production from 4 to 20 per cent in typical plants, beside bringing about many other advantages.

Maintenance and Repair

Importance of Lubrication—V. 621.89
E. G. Moan. *Modern Mining*, June 1925, pp. 188-191. Illus. Filtering purifies oil and enables it to be used over and over again. Correct methods of filtering and storing.

We Found These Better Ways to Clean. 658.58
Factory, July 1925, pp. 61-64, 104. Illus. Housekeeping methods which produce clean departments and a clean shop. Drawn from the experiences of five nationally known concerns.

General Management and Policy

Administration and Policy

Business Cases and Problems. 658
Leon Carroll Marshall. University of Chicago Press, Chicago. 359 pp. $3. Case material for classroom work, developed by the Department of Political Economy and the School of Commerce and Administration of the University of Chicago, and brought together in this volume for the use of instructors in other fields. Those presented are: The Noel Slate and Manufacturing Company; Kansas City Power and Light Company; Organization and Methods of the Walworth Manufacturing Company; The Danner-Kraft Dry Goods Company; Marketing the Stephens Brake Shoe; The Chicago Press Feeders Wage Arbitration Case; the Introduction and Development of the Works Committee in the Dennison Manufacturing Company; The Chicago Foundry Company; The Co-operative Society of America—A Common Law Trust; Organization and Methods of the Thayer Manufacturing Company.

Getting the Most Out of Your Machine Tool Dollar. 658.27
G. T. Christopher. *American Machinist*, June 11, 1925, pp. 907-909. Outlines a method of analysis against earnings to make sure that new equipment will prove profitable.

The Mechanical Officer and the Tool Builder. 621.9
E. F. DuBrul. *Railway Mechanical Engineer*, June 1925, pp. 331-332. Some possibilities for co-operation, as seen from the viewpoint of the machine tool industry.

Relation of the Equipment Manufacturer to the Chemical Industry. 661
H. C. Parmelee. *Chemical and Metallurgical Engineering*, June 1925, pp. 557-560. Closer co-operation needed, importance of servicing, some secrecy justified, place of the consultant, limit to free service.

Scientific Management and Organized Labor Today. 331.15
Geoffrey C. Brown. Bulletin of the Taylor Society, June 1925, pp. 132-153. Presents evidence and discusses the importance of the approach of organized labor to the philosophy and methods of scientific management. The conviction is stated that management engineers should meet this development at least half way, and extend every reasonable encouragement to advance the cause of management from the point of view of the workers.

Economics

Directory of Illinois Manufacturers. 31.67
Ernest W. Mau. Illinois Manufacturers Association, Chicago. 1595 pp. $10. This enlarged second edition is a thoroughly useful and usable volume which deserves to be duplicated for every manufacturing state. It gives the essential information in regard to every manufacturer no matter how small or large. The main classifications are Chicago manufacturers, state manufacturers, index to manufacturers, products produced in Illinois, index to products, miscellaneous data, and "Who's Who in Illinois Industry." The data have been secured from reliable sources. The Illinois Manufacturers' Association is to be commended for its initiative in presenting such a comprehensive volume devoted to the products and industries of the great state of Illinois.

Effective Regulation of Public Utilities. 650.6
John Bauer. The Macmillan Co., New York. 373 pp. $2.50. Principles and methods of public utility regulation and difficulties that have impeded this work. Written to serve accountants, economists, engineers and lawyers. After reviewing the purpose, fundamentals and development of regulation procedure, the author offers this plan in his conclusion: "For automatic rate control, we need first of all an appraisal of existing properties used in the public service to determine once for all reasonable and definite sums entitled to future return. . . . Subsequently all additional investments should be added to the initial valuation. Thus, the rights of the investors and the obligation of the public would be at all times shown by the accounts."

The Reds: Are They a Real Menace to American Industry? 335
Fred R. Marvin. *Iron Trade Review*, June 25, 1925, pp. 1629-1632. Illus. I—The germ of the communist disease. July 2, 1925, pp. 1-4, 7. Illus. II—Socialism and communism one and the same.

Work of the Forest Products Laboratory. 674
F. J. Champion. *Armour Engineer*, May 1925, pp. 129-130, 152. Illus. Studies made of strength, preservation, kiln drying, chemical derivatives, and uses of wood, conservation of timber in shipping containers, etc.

Management

American Manufacturing Management Sure of Adoption in Europe. 658
MANAGEMENT AND ADMINISTRATION, July 1925, pp. 5-6. Prague International Management Convention, Polish convention in December 1924, Brussels convention in October 1925, and translation of "Management's Handbook" into German show an awakened interest.

And This Firm Failed. 658
Richard Warren. *Candy Factory*, July 1925, pp. 32-34. Forms. Poor management in determining profitable lines, poor packaging, and failure to encourage salesmen to push products manufactured instead of jobber's lines, leads to business disaster.

Capitalizing the Advantages of the Small Factory—III. 658.5
Dale S. Cole. *Industrial Management*, June 1925, pp. 360-364. Illus. Controlling the flow of materials through the small shop.

Cutting Cleaning Room Costs. 658.5:651.72
Iron Age, July 2, 1925, pp. 1-4. Illus. Methods used by the Ferro Machine & Foundry Co. to reduce cleaning room costs. These include a large amount of up-to-date mechanical handling equipment.

Factory Losses and Wastes. 658.5671
Norman L. Sammis. *Industrial Management*, June 1925, pp. 321-329. Materials, storage, handling and power equipment, fire, packing, lighting, water, fuel and compressed air losses and their reduction.

Fitting Scientific Management to Chemical Industry. 658.5:661
Leo Baumeister. *Chemical and Metallurgical Engineering*, June 1925, pp. 551-552. Taylor's four principles are as useful in the chemical engineering field as in any other production work.

Metal Welding Process Important Step in Auto Production. 665.882:629.113
Automotive Manufacturer, June 1925, pp. 10-12, 26. Illus. How, when and where the oxy-acetylene blow pipe assists the manufacturer to make stronger, lighter or cheaper cars, trucks or tractors.

Our War Against Time. 658.5
William Cordes. *Factory*, July 1925, pp. 39-42. Illus. Methods of the Pro-phy-lactic Brush Co. in reducing the delays and securing fast manufacturing. The plan is to attack the highest peak of delay first, then the next, and so on, at the same time watching minor delays.

Round Table Promotes Efficiency in Metal Furniture Shop. 658.5
E. C. Barringer. *Iron Trade Review*, June 25, 1925, pp. 1637-1641. Illus. At the Kenosha plant of the Simmon's Company, weekly conference of department heads co-ordinates production. Wage system. Manufacturing methods.

Southern Furniture Plants Apply Modern Management with Success. 658:674
C. F. Scribner, MANAGEMENT AND ADMINISTRATION, August 1925, pp. 83-86. Service and maintenance functions of a furniture plant including economical department layout. Several records of savings due to improved operation are given.

The Six Ways to Eliminate Waste. 658.5671
Ray M. Hudson. MANAGEMENT AND ADMINISTRATION, August 1925, pp. 71-74. Methods for waste elimination are given in detail with an indication of the quantitative savings which have been made in typical cases.

Think of Your Scrap in Terms of Productive Labor. 658.5671
L. C. Morrow. *American Machinist*, July 9, 1925, pp. 41-44. An outline of what management must do to reduce scrap, including educating the factory organization, establishing co-operation between factory and accounting organizations; teaching operators in regard to the loss of scrap; setting up an adequate cost system to show the sums represented in scrap.

Waste Elimination. 658.5671
Harvey S. Firestone. *Factory*, July 1925, pp. 35-38. Illus. The plant program of the Firestone Tire and Rubber Co. in eliminating waste, and some of the results secured.

Welding Applied to Motor Production. 665.882:629.113
J. F. Lincoln. MANAGEMENT AND ADMINISTRATION, July 1925, pp. 37-39. Illus. Arc welding permits construction of steel frame motor with twice the output per man and half the overhead per dollar outlay as under former methods.

Power Generation and Transmission

Fuel

Advantage of Uniform Coal Contract. 621.18
H. W. Mitchell. *Steam Coal Buyer*, June 1925, pp. 17-18. An interesting address before the National Association of Purchasing Agents recommending the use of the standard form of coal contract.

Clean Coal: How to Get It. 621.18
Ralph H. Sweetser. *Iron Trade Review*, June 18, 1925, pp. 1575-1577. Illus. IV—Inspection and analysis essential for satisfactory fuel and to protect buyer and seller. Duties and work of a coal inspection department. July 2, 1925, pp. 10-11. Illus. V—Correct valuation based on carbon content. Heat unit is scientific buying basis.

Recovering Unburnt Fuel from the Ash-pit. 658.26
Engineering and Boiler House Review, June 1925, pp. 526-528, 530. Illus. Typical English installations utilizing magnetic separation. Savings in one case amount annually to 50 per cent of investment in recovering equipment.

Power Equipment

American Oil Engines in Pacific Islands. 621.4
N. P. Selover. *Oil Engine Power*, May 1925, pp. 291-293. Illus. Cocoanut Oil Refinery and central station on South Sea Islands, tended partly by Chinese, operate economically.

Boiler and Turbine Room Instruments. 621.18
W. A. Shaudy. *Electric Light and Power*, June 1925, pp. 177-178. Illus. Instruments are necessary to check losses and operate the plant to the best advantage.

Installation and Care of Power Switchboards. 621.31
Industrial Engineer, July 1925, pp. 327-332, 350. Illus. Recommendations of the Electric Power Club for proper erection, operation and maintenance of equipment.

An Oil Refinery's Power Plant. 621.31
Power Engineer, June 1925, pp. 222-229. Illus. At the Grangemouth "topping" plant of Scottish Oils, Ltd., an up-to-date and interesting electrical generating system is in operation.

Superheat Engineering Data. 621.18
Sixth Edition Revised. Published by Superheater Co., New York. 208 pp. Illus. $1. Handbook of condensed data for engineers and operators of steam power plants. It gives basic data for and illustrations of superheater arrangements in all ordinary types of stationary, marine and locomotive boilers used in the United States. Waste heat, portable and separately fired superheaters are also shown. Steam tables cover pressures from below atmospheric to 600 lb., absolute, and properties of superheated steam from 50 to 300 deg. fahr. superheat. The other section is devoted to piping, in which are the proposed American standards for high pressures. Data is also included on coal and oil fired boilers with table of heat values for gaseous, liquid and solid fuels.

Switchboards. 621.31
General Electric Co., Schenectady, N. Y. 120 pp. A paper bound booklet, bearing the number 87000-E, and covering the installation, operation and maintenance of switchboards. Illustrated with photographs, diagrams, tables, formulas, etc. Contains much varied information of especial value to switchboard attendants and construction men. Precautions for the avoidance of accidents are also included.

Power Plant Operation

Diesel Engine Maintenance Pointers. 658.26
Power Engineer, June 1925, pp. 230-232. Illus. Special reference to the periodic overhaul.

Generated vs. Purchased Power in Various Industries. 658.26
Journal of Electricity, June 1, 1925, pp. 412-415. Report of Competitive Power Committee, Power Bureau, Commercial Section, Pacific Coast Electrical Association, covering cement plants, laundries, sawmills, hotels, and Diesel engine installations.

High Sustained Economy in Industrial Plant. 658.26
C. J. Colley. *Power*, July 7, 1925, pp. 13-15. Illus. Results obtained by the Monsanto Chemical Works in operating a natural-draft chain grate power plant.

Making a Survey of the Power Load. 658.26
H. E. Stafford. *Industrial Engineer*, July 1925, pp. 310-315, 337. Illus. Methods of making the survey and analyzing results to cut power costs.

The Profits in Stoker Firing. 658.261
Francis Juraschek. *Industrial Management*, June 1925, pp. 354-359. Illus. Labor and fuel savings, with typical examples from the use of mechanical stokers.

Treatment of a Boiler Feed Water by a Zeolite Softening System. 658.261
Sheppard T. Powell and John H. Wolfe. *Industrial and Engineering Chemistry*, June 1925, pp. 584-585. Spring Gardens plant of the Consolidated Gas, Electric Light and Power Company installs a system costing $13,000, with annual operating charges of $3278, that purifies water at $0.04 per 1000 gal. and saves in maintenance, labor and fuel.

$20,000 a Year Lost Through Wrong Power Figures. 658.261
A. F. Sheehan. MANAGEMENT AND ADMINISTRATION, July 1925, pp. 39-40. A paper mill substitutes central station power for its own current, but finds that wrong cost accounting methods have led it into serious error in taking this step.

Power Transmission

Advantages of Belt Drive Over Direct Connection. 658.2621
C. C. Hermann. *Belting*, June 1925, pp. 17-19. Illus. Designed under common sense rules, with correct pulleys and shifters, belt drive is flexible and economical.

Power Service Layout for a Woodworking Plant. 621.34:674
Francis A. Westbrook. *Industrial Engineer*, July 1925, pp. 316-319. Illus. Electrical distribution system, motors, controls and drives planned for convenient, economical and safe operation in the new Albano and Co. factory.

Marketing and Distribution

Advertising

Advertising Procedure. 659.13
Otto Klepner. Prentice-Hall, Inc., New York. 539 pp. $5. A complete manual explaining the creation and presentation of advertising ideas. Illustrated by numerous specific examples and drawings. Divided into four parts covering the purposes of advertising, preparation of advertisements, scheduling advertisements, and the machinery in motion. At the end of the book are appendices giving a glossary of advertising terms, advertising abbreviations, bibliography and useful tables.

Is It Ever Safe to Base Appropriations on Last Year's Billings? 659.1
Sales Management, May 2, 1925, pp. 665-666. Advocates basing advertising budgets on future estimated sales instead of on past business.

Lime Promotion Through Association Literature. 658.821
Elfrieda H. Roth. *Cement, Mill and Quarry*, June 20, 1925, pp. 31-32. Methods by which group activity can develop increased use of a product.

Telling the World of Your Wares. 659.13
H. S. Riggs. *Machinery*, July 1925, pp. 865-866. Publicity methods used in marketing machine tools, based on Lodge & Shipley Machine Tool Co. practice.

Selling

Collection Correspondence and Agency Practice. 658.88
Theodore N. Beckman and Felix E. Held. McGraw-Hill Book Co., Inc., New York. 193 pp. $2.50. Based on the practice of the most successful collection managers. Presents various methods and policies employed by progressive collection departments, collection agencies and attorneys engaged in the collection of accounts. Possible improvements that may be inaugurated to advantage. Of the 12 chapters, 6 are devoted to collection department letters and their analysis. The other 6 chapters give the credit manager an insight into collection agency and attorney practice.

Exporting Machinery on Credit. 658.882
W. H. Rastall. *American Machinist*, June 18, 1925, pp. 965-968. The author takes the position that the majority of machinery export transactions do not need to be handled on a credit basis. Practice of German and British exporters.

How Manufacturer Can Assist the Distributor. 658.82
W. J. Radcliffe. *Belting*, June 1925, pp. 52, 54. Co-operation, personal contact, good advertising, fair prices and a uniform cash discount recommended.

Making Exports Balance Production. 658.82
Dirk P. De Young. MANAGEMENT AND ADMINISTRATION, July 1925, pp. 19-23. Developing export trade to compensate for domestic sales fluctuations. Experiences of several manufacturers and percentages of products which they endeavor to export.

They Multiplied Their Industrial Inquiries Twenty-five Fold. 658.82
Hartwell Chandler. *Printers' Ink*, June 18, 1925, pp. 17-20. Illus. Experience of the Milwaukee Corrugating Co. in developing inquiries from business and trade publications. Increase was 6000 over the preceding year.

What Sales Executives Should Know. 658.8
Gilbert H. Montague. MANAGEMENT AND ADMINISTRATION, August 1925, pp. 93-94. Sales practices that need careful consideration by the sales manager to avoid violating interpretations of the Federal Trade and Anti-Trust laws. Scope of recent decisions in regard to manufacturers' associations.

Shipping

Earthenware and Chinaware Packing. 658.788442
C. M. Bonnell, Jr. *Barrel and Box*, June

1925, pp. 19-22. Illus. Study made by the Freight Container Bureau of the American Railway Association at plants and railroad freight depots, to determine best methods and containers.

Electric Transportation and the Central Station. 656.124
Journal of Electricity, June 1, 1925, pp. 417-426. Report of Transportation Bureau, Pacific Coast Electrical Association, covering the advantages of electric trucks to industry, their economy, and what public utilities on the coast are doing to develop their use for the sake of the resulting charging load.

Packing Agricultural Machinery for Foreign Fields. 658.788442
John F. Keeley. *Barrel and Box*, June 1925, pp. 24-26, 47-50. Illus. Methods used and designs of crates and cases adopted to prevent damage in transit. Hints on packing for different countries.

Steel Heads for Wooden Kegs Decrease Cost of Distribution. 658.788444
R. T. Mason. *Iron Trade Review*, June 11, 1925, pp. 1518-1519. Illus. Manufacturing, handling methods, and economies of this type of container.

Material Handling and Production Control

Material Control

New System Brings Order from Chaos. 658.27
Foundry, June 15, 1925, pp. 473-475. Illus. Description of the classification system for pattern storage and identification used by the Richardson and Boynton Co.

New Type of Material Control Record. 658.78
Ralph E. Case. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 543-548. Illus. Applies the fact that materials are obtained by purchase and go either into finished product or waste, direct or indirect. Methods and forms used based on these factors leave only irregular occurrences to be specially cared for.

Purchasing and Stores. 658.7
Journal of Electricity, June 1, 1925, pp. 520-529. Reports of committees of Purchasing and Stores Section, Pacific Coast Electrical Association, covering handling of obsolete and scrap material and equipment, stores department budget, standardization, inspection and testing, supervision, procurement, handling devices, stationery and printing economy, purchasing department organization, stores department organization, annual inventories.

Worthington Tool Control Methods. 658.563
Anker L. Christensen. MANAGEMENT AND ADMINISTRATION, August 1925, pp. 95-97. Illus. Inspection and maintenance of tools, accounting system for purchases and repairs, methods of executive control.

Mechanical Handling

Handling Materials by Conveyors in Industry. 658.281
Earl Stearns. *Belting*, June 1925, pp. 38, 40. Material carrying equipment, with proper methods, is a big labor saver in any industry.

Mechanical Loading of Coal. 658.281
Abner Lunsford. *Modern Mining*, June 1925, pp. 192-196, 202. Tests made on the economies of McKinlay entry driver, Joy loader and Jeffrey conveyor at the Fordson Coal Co. mine.

New Plant Eliminates Hand Labor. 658.281
A. P. Walker. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 513-518. Illus. Standard Milling Co. puts up large modern building with extensive systems of belt, bucket and screw conveyors, elevators and chutes. Location and transportation facilities excellent.

Operating a Sand and Gravel Plant Under Exceptional Conditions. 658.281
F. A. Westbrook. *Pit and Quarry*, June 15, 1925, pp. 47-52. Illus. Stamford Local Materials Co. has completely electrified manufacturing operations.

Portable Lifting Tackle. 658.281
W. Dahlheim. *Engineering Progress*, May 1925, pp. 149-151. Illus. Portable elevators and dray ladders for hand and automatic operation.

Unusual Conveying System for Sand and Gravel Plant. 658.281
W. A. Scott. *Cement, Mill and Quarry*, June 5, 1925, pp. 34, 36, 38. Illus. Methods at the McGeorge Gravel Co.

Utilizing Advantages in Operating Crushed Stone Plant. 658.281
Pit and Quarry, June 15, 1925, pp. 37-42. Illus. Rock Cut Stone Co. operates modern hillside plant producing 3500 tons daily without elevating any material.

Westinghouse Shop Express System. 658.281
Stewart M. Lowry. MANAGEMENT AND ADMINISTRATION, July 1925, pp. 7-11; August 1925, pp. 75-78. Illus. Three routes served regularly by one industrial electric truck each, carry small packages between departments in the East Pittsburgh plant at an average cost of $0.044 each, and simplify transportation problem.

What Can the Older Plant Do About New Methods of Handling? 658.281
John F. Tinsley. *Factory*, July 1925, pp. 52-55. Illus. Emphasis on the importance of methods of moving material, of which the author says: "To my mind nothing has a greater effect on the cost of manufacturing than the transportation system."

Production Methods and Control

Assignment of Locomotives for Enginehouse Repairs. 658.5
Railway Mechanical Engineer, June 1925, pp. 325-330. Illus. Re-organized forces and co-operation increase efficiency in Sayre and other Lehigh Valley shops. Inspection and maintenance records, scheduling repairs, employee relations.

The Brains of Production. 658.5
C. B. Gordy. *Journal of the Society of Automotive Engineers*, June 1925, pp. 604-608. Elements of management, planning, standardization, estimates of production, sales analyses, flow layouts, stock records, maintenance.

Production Schedule a Factor in Auto Quality. 658.513
Arthur Murphy. *Canadian Machinery*, June 11, 1925, pp. 13-15, 41. Illus. Description of the assembly operations at the Oshawa plant of General Motors of Canada, Ltd.

Employment and Personnel Management

Employment and Training

Class Room Training of Employees. 658.3862
American Management Association, Committee on Training Methods, Geo. B. Thomas, Chairman. Booklet, 52 pp.

Experimental Psychology in Personnel Problems. 658.3115
C. S. Yoakum. Bulletin of the Taylor Society, June 1925, pp. 154-163. Emphasis is placed on the need of additional quantitative analysis in such problems as the curve of learning, wages, individual differences, employment and labor turnover.

Getting Trained Leadership for the Factory. 658.386
J. K. Novins. *Industrial Management*, June 1925, pp. 345-348. Methods of getting foremen to analyze production problems, based largely on Dutchess Manufacturing Co. plans.

Training Foremen in Leadership. 658.386
Railway Mechanical Engineer, June 1925, pp. 364-369. Staff meetings, clubs, educational classes, study courses, and ideas on promotion in the shops of several railways.

Training Machinists in the Reo Plant. 658.3862
Charles O. Herb. *Machinery*, July 1925, pp. 847-851. Illus. A maximum of 200 apprentices at a time, divided into three classes, are successfully trained by the Reo Motor Car Co. in drafting and shop work, and most of them remain with the company.

Personnel

A Company Personnel Program. 658.315
T. P. Sylvan. American Management Association Booklet. 8 pp. Outline of personnel program of the New York Telephone Co.

Industrial Democracy in a Foundry. 658.3151
Paul A. Ivy. *Iron Age*, June 18, 1925,

pp. 1785-1786. Outline of the plan used by the American Cast Iron Pipe Co. whereby the plant and business is owned by the employees and managed by them on these principles: (a) A reasonable living wage to the lowest paid workman; (b) regular employment to every member of the organization; (c) an actual application of the Golden Rule to relations between the company as producer and the public as consumer.

Labor Treatise (Arbeitskunde). 658.3
Edited by Johannes Reidel. B. G. Teubner, Leipzig. 364 pp. 15 G. M. ($3.60). In German. Fundamental principles, conditions and aims of economic labor. Scientific study of the social, hygienic and vocational aspects of work. Among the topics treated are: Hygienic effect of economic development; social polity and labor laws; economic business management; anatomical, psysiological and psychological bases of work; hygienic condition of work; psychic effects of the human environment; wage payment; media of work; motions in work; working time; working periods and free time in relation to health and culture; education and work; vocational guidance; choice and distribution of occupations; instruction and vocational schools; education in skilled and unskilled crafts; business education; methodics of labor investigations.

Safety

Causes of Accident in Material Handling. 658.382301
David S. Beyer. *Forging—Stamping—Heat Treating*, June 1925, pp. 209-212. Illus. Sixteen industrial accidents analyzed, showing that men with organic weaknesses should not be put at heavy work, and equipment should be used wherever possible.

Health Maintenance in Industry. 658.3822
J. D. Hackett. A. W. Shaw Co., Chicago. 477 pp. $5. Written primarily for the plant manager, whose concern is to maintain the worker in health as a means of facilitating production. Medical and surgical detail is not presented except where necessary from the plant manager's viewpoint. Divided into 5 parts: Health Maintenance, The Medical Department, The Surgical Department, Plant Hygiene, and Plant Sanitation. Several topics are presented in the last three parts which are often considered of an engineering responsibility, such as the prevention of accidents, ventilation, heating, lighting and the up-keep of the sanitary utilities.

Manual of Health Supervision. 658.3822
R. S. Quinby. American Management Association Booklet. 19 pp. A concise statement of the generally accepted methods of dealing with health supervision in industry, written for industrial executives.

Real Safety Movement to Come. 658.3823
MANAGEMENT AND ADMINISTRATION, August 1925, pp. 61-62. Analysis of the safety movement as it now is organized showing need of more fundamental progress. The opinion is expressed that this will come through arousing executive interest and responsibility.

Reduced Lost Time Accidents. 658.3823
N. J. Darlin. *Safety Engineering*, June 1925, pp. 239-243. Methods of eliminating the causes and reducing the number of accidents in plants of the General Electric Co.

Accounting and Financial Control

Accounting and Cost Finding

Cost Accounting and Foremen's Departmental Activities. 657.452
T. M. McNiece. National Association of Cost Accountants, Official Publication. July 1, 1925. 12 pp. Profitable use of cost information by minor executives such as foremen. Practice of the Union Carbide and Carbon Corp.

Costs for Oil Producers. 657.4
R. W. Cobb. National Association of Cost Accountants Official Publication, June 15, 1925, 12 pp. Classification of the principal investment accounts in the production of petroleum. Brief description of some of the main items.

Practical Balance Sheet Analysis. 657.4
G. M. Pelton. MANAGEMENT AND ADMINISTRATION, July 1925, pp. 27-28. Advantages and disadvantages of the index and the ratio methods.

Simplifying Cost and Price Figuring. 657.452
Rudolph Rosenthal. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 535-536. Chart. Formulas used by Jacques Kahn, Inc., to calculate manufacturing costs and selling prices on mirrors.

What the Paper Mill Executive Wants From the Accountant. 657.452
W. W. Sunderland. *Paper Trade Journal*, July 2, 1925, pp. 42, 44, 46, 48, 52. The author, who is president of the Miami Paper Co., outlines five functions for the cost accountant: (1) To furnish facts and figures for the plant; (2) to budget and keep expenditures under control; (3) to budget all planning; (4) to budget production and keep it under control; (5) to furnish estimates of cost.

Financial Control

Budgeting Co-ordinated Sales and Production. 658.14
Edward H. Tingley. MANAGEMENT AND ADMINISTRATION, August 1925, pp. 67-70. Outline of methods of Delco-Light Co. in developing a sales program and making its needs a part of the factory or production program. Major results and methods of operating on a budget basis.

Practical Results of Budgeting. 658.14
Ralph H. Allen. MANAGEMENT AND ADMINISTRATION, June 1925, pp. 527-530, July 1925, pp. 11-14. Methods of business forecasting and budget building in the Thomas A. Edison Industries by which sales forecasts one year ahead prove 91 per cent correct, and monthly estimates of sales, expenses and profits are less than 5 per cent in error.

Valuation of Intangibles—II. 657.42
Howard W. Roper. *Electric Light and Power*, June 1925, pp. 171-172. From 10 to 30 per cent of an electric service company's value is intangibles and a correct valuation of these is vital to the business.

New Industrial Equipment

Pneumatic Drill. 621.95
A new line of 4-cylinder pneumatic drills, including both reversible and non-reversible sizes and designed with long stroke, has been placed on the market by Ingersoll-Rand Co.

60 In. Dial Power Meter. 621.31
Readable at 250 ft. Indicates total load. Pointer driven by motor. Furnished with either a polyphase wattmeter element to operate from transformers or a D. C. ammeter element to operate from metering apparatus. Black dial with white figures, illuminated by concealed lamps. Case 72x72x30 in., sheet steel and angle iron, dust tight, plate glass in door. Made by Westinghouse Elec. and Mfg. Co.

Steel Switchboard. 621.31
Constructed of "stretcher level sheet steel," light, substantial, sturdy and easily erected, since framework is integral part of panel. Finished in baked enamel to resist corrosion. Low in maintenance cost. Made by Westinghouse Electric and Mfg. Co.

Undervoltage Device. 621.31
Self-resetting, for large, solenoid operated, air circuit breakers, 3000, 4000, and 6000 amps. Armature, after tripping breaker, is brought back to reset position against core until voltage returns. A permanent part of breaker and integral part of frame. Made by General Electric Co.

Steam Separator. 621.18
New design of Stratton type, with larger helical path and a spatter cap on the outlet to increase efficiency. Cast iron, ½ to 2 in., 250 lb.; 2½ to 8 in., 200 lb. Steel, all sizes to 8 in., 250 lb. Sizes 2½ in. up flanged. Made by Griscom-Russell Co.

Tier Lift Truck. 621.86
Capacity 4000 lb., lifting height 6 ft. Overall height 87 in., width 41 in., length 112 in., wheel base 59 in., turning radius 95 in., platform 26 by 54 in. Elevating unit, worm and worm wheel to a single screw. Made by Crescent Truck Co. Driving unit interchangeable with other Crescent trucks. All working parts accessible beneath platform.

MANAGEMENT
AND ADMINISTRATION IN
MANUFACTURING INDUSTRIES

VOLUME X SEPTEMBER, 1925 NUMBER 3

Modern Equipment Brings Low Costs

Advances Since 1920 Make Many Older Types Unprofitable

MANUFACTURING equipment is still supreme in industrial production. Its position and importance have been repeatedly challenged in recent years, at least by inference. Just recall all that has been said and written about "The Human Factor in Industry." Then consider that the manufacturing output of 10,000,000 American workers and our producing equipment is estimated to be equivalent to that which would be produced by 2,000,000,000 slaves working without machinery. And again consider that the railroad equipment of this country, manned by 1,800,000 employees, does the work of 140,000,000 horses and 70,000,000 teamsters in transporting freight.

It is never safe to assume that costs cannot be cut. The radio and commercial airship—both new since the War—but parallel progress in other fields, one being manufacturing equipment. The industrial executive has opportunities never before available, to reduce costs, improve product and earn an increased profit by (1) better use of existing equipment, (2) installation of modern equipment, (3) development of new equipment. Possible savings are almost unbelievable until demonstrated.

Unaided, the industrial worker can produce but little, and at great cost, even though he labors long hours. Give him manufacturing and transporting equipment to use and he can turn out more product in a given time and at less cost than any other worker in the world. His achievements, realized through the utilization of our manufacturing equipment, are enormous. Statistics of the census figures compiled by the Department of Commerce, and secured through private organizations, reveal, with a little interpretation, a human romance of most intense interest. On the one hand has been victory over the forces of nature; on the other has been a tremendous increase in the comforts and luxuries of human life. Truly the old world is a good place to live in because of what industry produces.

But the possibilities of industrial success have by no means been exhausted; in fact, probably only the surface has been scratched. Equipment requires the constant attention of every manufacturing executive. Opportunities are everywhere present:

1. To make better use of existing equipment.
2. To install better equipment.
3. To develop new equipment.

All three of these opportunities are continually being grasped by those who are reducing costs, improving product and operating with maximum effectiveness and profit. As to the new equipment, much of that developed in the past five years has made obsolete all previous installations.

Turning to types, it is convenient to divide them into two groups:

1. Processing machinery which performs directly some transforming operation on material or work-in-process.
2. General factory equipment which contributes indirectly but indispensably to the manufacturing process.

The strong tendency in processing equipment is toward greater automaticity. This is by no means new, but it is becoming of increasing importance due to scarcity of skilled labor and necessity of reducing unit labor costs. As a manufacturer of shoe machinery said: "We are constantly working toward an ideal perfection of shoe machinery which will take a steer's hide at one end and deliver a pair of shoes in a box ready to

ship at the other."

The second type of equipment, that of general use, offers some of the greatest possible savings and cost reducing advantages to the manufacturing executive. For convenience this kind can be divided into:

1. Modern factory buildings and building construction.
2. Modern material handling machinery.
3. Modern power equipment.
4. Modern fixed equipment to establish and maintain working conditions.

It is difficult, if not impossible, to show exact dollars and cents savings from the adoption and use of modern factory building construction, over the older forms. But the advantages and conveniences of the newer types are self-evident, and no argument is needed to prove superiority.

Arrangement of areas, levels and general design to fit manufacturing processes; fire-resisting materials; efficient widths, ceiling heights, and roof construction; convenient entrances, exits, and service facilities, especially adapted to departmental layouts making convenient the handling of incoming and outgoing freight—all these and many more factors found in modern factory building construction were unknown a quarter century ago. The values of these features in influencing volume and cost of production is shown:

1. By the many plants where old but still serviceable buildings have been torn down to make way for modern construction.
2. By the many plants which have been moved into new buildings erected on new sites rather than into existing buildings which might have been purchased at attractive prices.

As one manager puts it: "To get good help today, you must have good, clean, modern, well-equipped factory buildings." Another manager has written: "The only building that is a genuine monument to a great business is one whose daylight, sunlight, appointments and facilities contribute to the welfare of those who pursue their trade within its walls."

Material handling as a manufacturing operation is just beginning to be considered in its true importance. It is likely that as much time and human effort is spent in moving materials and goods in manufacturing as in actual processing of the materials or work-in-process. The possible savings from mechanical handling are often enormous, almost beyond belief until the facts are studied. The following typical cases are taken from recent past issues of this magazine:

Portable Conveyors Handling Coke
Cost of series of three $3500; saved per year $1672
Annual return on investment 48%

Overhead Conveyor System for Paper
Cost $600; saved per year $426
Annual return on investment 71%

Lumber Lift at Cut-up Saw
Cost $2000; saved per year $2000
Annual return on investment 100%

Pneumatic Conveyors for Cotton Bagging
Cost $7909.20; saved per year $11,390
Annual return on investment 144%

Power Transfer Car for Lumber
Cost $2500; saved per year $4000
Annual return on investment 160%

Electric Hoists
5 1000-lb. capacity, used to handle paper
Cost $2250; saved per year $4169.60
Annual return on investment 180%

Pneumatic Cotton Conveyor System
Cost $1683; saved per year $5670
Annual return on investment 337%

Electric Hoists
2 two-ton capacity, 1 three-ton capacity
Cost $1550; saved per year $9352
Annual return on investment 600%

In addition to savings such as these is the advantage of control of production which often can be made dependent upon the mechanical handling devices. The Ford plants are our outstanding example of thus tying together mechanical handling and production control.

Modern equipment for the generation and transmission of power has made as great advances as other types during recent years, and the possibilities of saving are great. Two sets of facts also taken from recent issues of this magazine are typical and significant:

A small industrial power plant increased its efficiency from 65 to 72 per cent by installing new instruments as one step in improving operation.

A large industrial power plant burning about 12,000 tons of coal per year installed new coal handling equipment at a cost of $31,096 and saved $12,904 in operating expenses during the first year.

Facts are also available as to the savings and improvement due to modern fixed equipment. A few such examples are:

In a number of installations where comparative production records were available it was found that proper ventilation increased production as much as 10 per cent and in a few instances from 15 to 18 per cent.

Modern lighting equipment in 28 cases increased production from 4 per cent as the smallest gain to 20 per cent as the greatest.

Modern cafeterias in 8 cases increased production by an average of 6.25 per cent, the individual factors ranging from 4 to 9 per cent.

Examples of this kind can be multiplied as far as desired. The proof is overwhelming as to the economic savings and advantages of modern manufacturing equipment. Its adoption and use is the solution of many business difficulties.

Much has been said and written about the excess of plant and equipment in this or that branch of American industry. If the word "excess" is modified by "poor" or "uneconomical" there is a world of truth in such statements. In the event of a lessening supply of crude labor, continuing high wages, rising standards of living, and keen competition, the American manufacturer must install and use the most efficient equipment on earth. Fortunately it is available.

The Modern Manufacturing Plant

American Type Founders Company Builds Largest Automatic Printing Press Factory in the World

By JOHN F. FALLON

Assistant Manager, Kelly Press Division, American Type Founders Company

OVER ten years ago the American Type Founders Company started production on a new design of automatic press invented by William M. Kelly. The new machine was well adapted to the needs of the trade and the business grew rapidly. It expanded so fast from the 1000 sq. ft. originally allotted to it for manufacturing purposes in the Jersey City plant of the company, that in 1924 an entire new factory devoted solely to this branch of the business became an absolute necessity.

A thorough study of present and future manufacturing requirements was made, and the question of plant location was carefully investigated. Many possible sites were examined and several buildings for sale at the time were taken under consideration. Important factors enter into the selection of a site and a tremendous investment is involved in erecting and equipping a manufacturing plant. Hence, these matters are not to be entered into hastily and unadvisedly.

So many fundamental improvements have been made in plant construction and factory equipment since the war that it was found impossible to take over any of the plants offered for sale and adapt them effectively to present-day requirements. The problem therefore became one of designing a building which would serve the needs of production with the greatest ultimate economy.

A 10-acre site in the west part of Elizabeth, New Jersey, was already owned by the company. It was decided to utilize this, after which the design and layout of the proposed plant were thoroughly studied, developed and carried into execution.

The considerations which prompted building in Elizabeth were the following:

1. Convenient to Metropolitan district.
2. Low cost of land permitted the erection of the plant along lines of maximum production at minimum expense.
3. Ample land (owned by the company) for future expansion.
4. Convenience of sources of materials, castings, etc.
5. Siding from Central Railroad of New Jersey gives direct access to all parts of the continent by rail and to all eastern ports for foreign shipment.
6. Retention of working force by reason of the short distance of removal from previous location.
7. Healthy working conditions and pleasant surroundings.
8. Excellent opportunity for the working force of 800 employees to live convenient to the plant, which is in a good residential part of the city.
9. Opportunity for employees to acquire their own homes in the new locality.

The total size of the plot of land owned by the company is 200 by 2300 ft. The building erected has a frontage of 165 ft. and a depth of 840 ft. The front is set back 130 ft. from the curb line to allow room for a well-kept lawn, and trees and shrubbery for land-

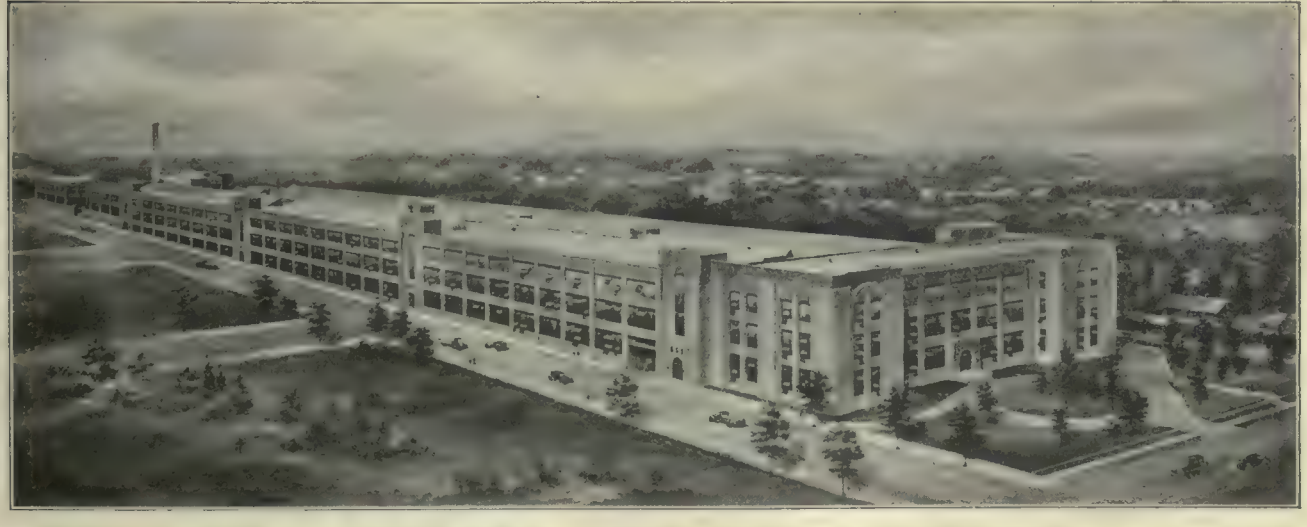


FIG. 1 PLANT OF THE KELLY PRESS DIVISION OF THE AMERICAN TYPE FOUNDERS COMPANY

scape gardening. A street runs down one side of the the plant, and the main line of the Central Railroad of New Jersey along the other.

A commercial Gothic style of architecture was selected, on account of the semi-residential character of the locality, and red brick with stone trim was used for the walls, to harmonize with the surroundings. The framework is of steel construction, and fire-resisting materials were used throughout.

General Proportions of Building

Good appearance and best layout from a production standpoint both dictated a long, low building, and hence three stories were set as the maximum height. A part of the building along the railroad side is of two-story construction, however, to enable ample daylight to be supplied to this portion by means of skylights in the roof. A total of 250,000 sq. ft. of floor area is provided, or 250 times the original space occupied 11 years ago.

On the ground floor, from front to back, are the employment department, wash room, shower and locker room, bar-stock receiving department, machines for producing round work, such as gear cutters, vertical turret lathes and automatics, nickel and copper plating, and heat treating departments, storeroom for a part of the castings, and switchboard, transformers, compressor and well water pump rooms.

On the second floor, at the front is the office. Along the railroad side are the tool room, grinding, drilling and milling departments, planers and other motor-driven tools, and heavy milling department. Along the street side are erecting departments for the Kelly Automatic Jobber, Style B and No. 2 presses. Down the center are stockrooms, inspection departments, testing departments and toilets. At the rear are the packing and shipping departments, covered shipping platform, sand blasting, cleaning and painting rooms for castings.

On the third floor, sub-assemblies of the three types of presses are made, each immediately above the parent machine erected on the floor below. Elevators take the sub-assemblies down to the second floor, and thus travel of parts is reduced to a minimum. The engineering and experimental departments and the drafting room are also on this floor.

As shown in Fig. 1, there are four towers along the street side of the plant and one at the front on the railroad side. These contain stairways that serve as fire exits as well as means of communication between floors. The stairway walls are of brick and the stairs of steel construction, the steps being concrete, with steel safety treads. Pipe is used for railings.

All windows throughout the plant are steel sash with 14 by 20 in. panes. In the office, these panes are plain transparent glass. In the factory they are of wire glass, ribbed on the north side to distribute the light and eliminate glare, and transparent at other points. The ratio of total window area to total floor area is 25 per cent.

Hand operated sections of the sash can be opened by bar and pin attachment for ventilation. As no dust or fumes are produced in manufacturing, except in grinding operations, and in cleaning and painting castings, where exhausters are installed, no other

FIG. 2 SAW-TOOTH ROOF CONSTRUCTION, GLASS ON NORTH

methods of ventilation, air washing or conditioning are employed.

The roof, which is partly over the third story and partly over the second, is of pre-cast gypsum slab construction, equipped with saw-tooth skylights running down its entire length (Fig. 2). These skylights have glass only on the north side. This glass is wire-inserted and ribbed. The sash is of steel, and is opened for ventilation by means of hand-operated chains.

Walls inside of the plant are of brick, painted a dark green for a height of 4 ft. from the floor, and white above to obtain maximum illumination. Steel columns and interior partitions, except tool room and storeroom cages, are likewise painted green on the lower portion and white above. Ceilings are of concrete, painted white. The steel roof trusses, where exposed, and the under side of the gypsum slabs are also white. The only place where artificial light is required during the day is toward the middle of the first floor, where stockrooms are located. In the office, the walls and ceiling are plastered and painted cream color.

Floors and Partitions

Floors throughout the plant are composed of wood blocks set on end on a concrete base. This type of flooring is resilient, quiet, firm and exceedingly durable. It is comfortable to stand and walk on, absorbs the shocks of machinery and traffic, and makes trucking easy.

Partitions around elevators and to enclose permanent departments are of brick or of steel framework with cement plaster on both sides. Factory office partitions are of wood, lined inside and out with sheet rock. Partitions around the tool room and stockrooms are of steel up to a height of 4 ft. and heavy diamond-shaped wire mesh above. Shelving and bins for the storage of finished and unfinished materials are also

of steel, painted a dark green. As a large variety of materials and parts is required, these partition and shelving installations are extensive. One never knows when radical changes must be made in plant layout to suit altered conditions of manufacture. Hence, the use of this type of movable partitions and material storage facilities is an economy. With very little adjustment they can be totally rearranged, with every piece salvaged, thereby eliminating the waste and also avoiding the fire risk of wood installations.

The plant is practically a daylight building. Where artificial illumination is needed, and to take care of night work in all places, Mazda lamps and reflectors, white inside and green outside, are hung from the ceiling at 10 ft. centers each way. (See Table 1.) A height of about 11 ft. has been found most suitable, and 75- and 100-watt bulbs are used in most cases. In the office, opaque white globes entirely enclose the lamps.

Throughout the plant no shades or blinds are required, as ribbed glass in the factory eliminates glare. In the office, which faces east, transparent glass is used. Consequently, some form of protection is necessary, and slat blinds have been adopted for the purpose.

Power and light are both purchased. Current is supplied at 2400 volts to a 1200 kw. sub-station in the plant. The wires come in underground to a rotary converter, which steps down the voltage to 220 for the power circuits and 110 for the lighting circuits.

A steam plant has been installed for heating purposes. It is located in a separate building, likewise of red brick, with steel sash and wire glass windows. Two 300-hp. boilers equipped with semi-automatic stokers generate steam at 100 lb. pressure (Fig. 3). The power plant is equipped with feed water pumps, blowers for forced draft, open-type feed water heater and purifier, etc. A brick stack, 150 ft. high and 7 ft. inside diameter at the top, furnishes natural draft.

Coal arrives at the plant in gondola cars, and is delivered to a siding by the power house. Here it is dumped into a track hopper, and fed to a bucket elevator carrying it to an overhead steel storage bin inside of the boiler room. The bin discharges into chutes leading directly to the stokers. Hand labor is practically eliminated.

On account of the residential character of the neighborhood, anthracite coal, of pea or buckwheat size, is the only fuel used. During the summer a reserve stock for winter use is stored in the yard adjacent to the power house.

Ashes falling from the grate are drawn out at the ash pit door and fall into a steam ash ejector. They are conveyed overhead and outdoors to a steel storage bin. From this point they are discharged either into a railroad car or into auto trucks for removal.

The Heating System

Steam for heating at 100 lb. initial pressure is carried from the boiler room into mains running the entire length of the ground floor. At six points along the line, risers are tapped off of this main through reducing valves which lower the pressure to from 5 to 10 lb. according to outside temperature. Each riser supplies six bays on all floors in the section from which it is tapped. Each of these floors is under the control of a thermostatic temperature regulating valve, so that correct conditions are maintained in all parts of the shop at all times. Vacuum pumps remove the air and water from the return lines running back along the ground floor, and deliver the condensate to the boiler room for re-use.

Wall-type radiators are installed along both sides of the building and also overhead under the skylights on the second and third floors. Altogether 38,000 sq. ft. of direct radiation have been installed, or 1 sq. ft. for every 50 cu. ft. of space to be heated.

The power plant and the wood working shop are both in separate buildings at the rear of the present main factory. Future expansion will take place in this direction and will leave the power house in the center of the ultimate plant, where it belongs. The steel work and the back of the main factory building have been erected with provisions for the future additions.

The plant secures its water supply from artesian wells. The water is pure, and is cheaper than the city supply. Two deep well pumps raise this water and discharge it into two large pressure storage tanks in the basement of the building and an air compressor main-

TABLE 1. ILLUMINATION DESIGN AND TEST DATA*

Building	Floor	Factory Section	Lamp Watts	Height of Work Plan	Depreciation Factor Per Cent	F. C. Intensity				Type of Reflector	Height	Lamp Spacing	Watts Sq. Ft.
						Design		Test					
						With 30% Depreciation	Without Depreciation	With 30% Depreciation	Without Depreciation				
B	Basement	"Gridley" Automatics	150	4 ft.	30	8.65	11.3	8.5	11	RLM	12 ft 6 in.	10 ft. x 10 ft.	1.5
B	"	Storage Bins	75	2 ft. 6 in.	30	2.8	3.65	3.8	5	RLM	12 ft. 6 in.	10 ft. x 12½ ft.	0.5
O	"	Front Entrance	150–200	Floor	30	—	—	—	1	Ornamental Fixtures	—	13 ft.	0.53
O	"	Employment Office and Chief Engineer	150	2 ft. 6 in.	20	8.1	9.8	8.4	10	Trojan	12 ft.	8 ft. x 9 ft.	2.2
O	Main	Main Office	200	2 ft. 6 in.	20	10.0	13.0	10.0	12	"	12 ft.	10 ft. x 15 ft.	1.36
O	"	Manager's Office	200	2 ft. 6 in.	20	11.0	14.5	12.5	15	"	12 ft.	10 ft. x 10 ft.	2.2
A	"	Machine Shop	150	2 ft. 6 in.	30	8.15	10.6	7.7	11	RLM	12 ft. 6 in.	10 ft. x 10 ft.	1.5
A	"	Large Machine Shop	150	2 ft. 6 in.	30	8.15	10.6	9.25	12	RLM	14 ft.	10 ft. x 10 ft.	1.5
B	"	Testing Department	100	2 ft. 6 in.	30	5.1	6.6	4.6	6	RLM	14 ft.	10 ft. x 10 ft.	1.0
O	2nd	Cafeteria	150	2 ft. 6 in.	30	3.7	4.8	3.85	5	RLM	12 ft.	14 ft. x 16 ft.	0.7
A	"	Stairway	50	Floor	30	—	—	—	0.75	CRI Globe	—	16 ft.	0.525
A	"	Bench Assembly	150	2 ft. 6 in.	30	8.15	10.6	9.25	12	RLM	12 ft. 6 in.	10 ft. x 10 ft.	1.5

* Courtesy, Day and Zimmermann, Inc., Engineers.

tains pressure on these tanks to transmit the water through the service lines, for use in drinking fountains, wash rooms, toilets, steam generation and fire protection. Sanitary drinking fountains supplied from a separate line are located at 30 convenient points throughout the shop and office, and the drinking water never exceeds 56 deg. in temperature. Hence, refrigeration is not required. Water lines are felt-insulated to prevent dripping of condensate. Make-up water is obtained from city lines when the well water supply is deficient.

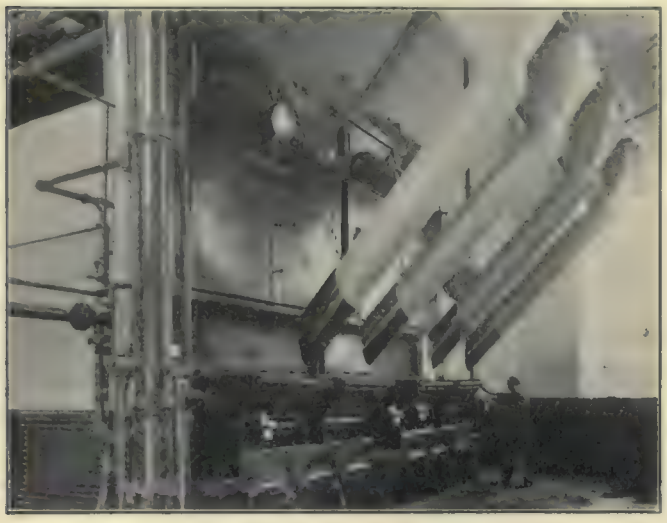


FIG. 3 BOILERS AND STOKERS

Power Transmission

Direct-connected motors, chain drive and belt drive are employed for power transmission. Line shafting lengths have been limited, as far as possible, to about 30 ft. to standardize on motors of 30 hp. for drives, and to simplify overhead rigging. Power losses are reduced to a minimum by the adoption of standard ball bearing hangers to carry both line and counter shafting throughout the entire plant.

Chain drive is used in several cases where close quarters prevented the application of belt drive. In other cases belts are used to transmit power from line shafting to countershafts, and thence to machines.

Certain machines, especially planers, which reverse, are direct-driven. Motors operated through controllers actuated by the machine itself are employed. Some of the planers are also equipped with small motors to raise and lower the heads when setting up work.

The pulleys on the countershafts are mostly of cast iron and come with the machines. Those installed on the main line shafting were bought separately and are of the built-up steel type, which is both light and strong.

All materials arrive at the plant either on the railroad siding, at the rear on the second floor level, or by auto truck. The materials coming in by truck at the rear of the plant can be taken directly to either the third or first floor level by elevators. Shipments are made from these same platforms and go out either by railroad or by auto truck. Loading and unloading of materials and shipments are handled by means of the traveling hoists and cranes in the receiving and shipping departments.

The plant was laid out to avoid back travel and crossing of parts in processing, and to eliminate as much handling of materials as possible. The equipment purchased for the purpose was required to be quick, convenient and effective. At the back of the plant a concrete ramp was constructed so that trucking from the yard to the second floor is possible. Receipt of materials, and much of the processing and assembling of parts occur on the first and second floors. Shipments of completed presses are sent out from the second floor. Hence the handling problem was greatly simplified by this ramp. In addition, four freight elevators, two of 6000 and two of 8000 lb. capacity, are located down the center of the building at convenient points to take care of vertical travel of quantity lots and sub-assemblies.

Tote boxes, mostly of steel and standard size, are used as receptacles in which to deliver parts to machines. After the operations are completed the parts are again placed in these tote boxes for delivery to the next process. In practically all cases the tote boxes are handled on lift platforms, so that material can be immediately removed when finished and replaced by new work.

Hand lift trucks are employed for the smaller parts, and over shorter distances. Electric lift trucks are used for heavy parts carried longer distances, specially from floor to floor. When it is necessary to move assembled presses or machinery about the plant in places not served by overhead cranes, an electric crane truck is utilized.

An extensive system of overhead cranes and hoists has been installed to serve machine tools on heavy work, to handle castings and sub-assemblies in the erecting department, and to deliver completed machines and parts to the shipping platform. (See Fig. 4.) These cranes are located as follows:

SECOND FLOOR

Planer department	Three 1-ton cranes
Heavy milling department	One 1-ton crane
Machine tools—motor driven	Two 1-ton cranes
Printing press assembly	Six 2-ton cranes
Assembly to packing department	One 2-ton traveling hoist
Testing station	One 2-ton hoist
Packing department	One 3-ton transfer crane
Shipping platform	Three 3-ton traveling hoists

FIRST FLOOR

Receiving department bar stock	One 1-ton traveling hoist
Receiving department castings	One 1-ton traveling hoist

Hand-operated chain hoists are in service at a few individual machines where the work is sometimes heavy, but infrequency of use does not justify the expense of an electric hoist.

Steel bar stock is received on the first floor at the truck entrance, shown in Fig. 1. A hoist, traveling on an I-beam track, of U shape, with the open end

of the U at the entrance, takes the incoming material back to the storage racks where it is unloaded. Short ends are stored in racks at one side of the main section. Immediately back of this storeroom is a band-saw cut-off machine in which the bars are cut to the short lengths required for manufacturing purposes. From this point they are transported in tote boxes by hand or electric truck to the machines for processing.

Castings are received on auto trucks at the rear of the building. They go first into a cleaning department on the second floor. After all sand and rough spots have been removed they are taken to the machines on which they are to be processed, or to storage cages on either the first or second floor, according to the nature of the work. Electric trucks operating lift platforms handle these castings, and the ramp enables them to be taken to the lower level quickly and conveniently. Plans are now under way to construct a cleaning and storage building at the rear of the present plant, to provide more room for the painting department adjacent to the present cleaning room, to remove the dust and dirt of cleaning from the main structure, and for storage purposes.

Layout of machinery was studied with special reference to eliminating handling of work wherever possible. Some machines are grouped by type, such as planers, milling machines, etc. Others are grouped according to a sequence of operations on parts. Neither system is followed at all rigidly. The whole idea is that parts

FIG. 4 CRANES AND HOISTS

which are essentially flat work shall be machined on the second floor, while those of an essentially round nature are to be processed on the first floor. The third floor is used for sub-assembly work.

Hence, a part of round shape comes in, either as bar stock or a casting, on the ground floor, is finished there and then is taken either to the storeroom on the second floor, if it is to go in the main part of the press, or to the third floor, if it goes in one of the sub-assemblies. A flat part, if a casting, arrives on the second floor, is machined and either is put in stock there for use by the assembly department on the opposite side of the room, or is sent to the sub-assembly department on the third floor. If a flat part is made of bar stock, it arrives on the ground floor, is cut to size, delivered to a machine on the second floor, and finally goes to storage or to sub-assembly.

Factory benches are of wood on steel framework. In some cases, where much work is done on the benches, they are covered with galvanized sheet. Stools have been provided for the comfort of workers wherever possible. These are of steel, but in most cases have wood seats.

Service Equipment

Everything has been installed that would add to the convenience of the employees. At the front on the ground floor are large dressing rooms. Each employee has a separate steel locker. Shower baths, supplied with heated water from gas heaters are installed in this room. Ample washing facilities are provided in the toilet rooms. Seven toilets are located on the first floor, seven on the second floor including the office, and six on the third floor. Toilets are also installed in the locker and shower room, which is specially vented to the roof. All these service rooms are fitted with the newest sanitary porcelain equipment, the average being four closets, three urinals, and two wash basins.

Fire-resisting construction is used throughout. All doors in the factory are of fire-resisting type, oak base covered with sheet metal. Doors between office and shop, and those on the outside of the building are of hollow metal. The floor, although of creosoted block, is non-inflammable. Tests have shown that this type of material will, at most, only slightly char even under a fierce fire. Columns, walls and ceiling, the product, and practically all of the equipment are non-combustible. Automatic sprinklers and fire extinguishers are installed in the shipping, wood working and painting departments, the only places where fire might suddenly occur and gain any headway. There are 25 city fire alarm boxes within the plant, so that any conflagration can be handled almost immediately by experienced firemen. Fire hose, connected to the water mains, is installed at convenient points. A watchman's system for night, Sunday and holiday protection guards the plant at times when the working force is absent.

Communication from the outside, between different parts of the plant, and with the office is maintained by means of telephones operating through a central switchboard.

Employees ring up their time on cards when entering and leaving the plant. For the proper control of production and cost accounting, the Periodograph system of time keeping has been adopted, with 6 min. periods (1/10 hr.) as the unit, on account of the ease of calculating.

Safeguards have been installed at all points where accidents are at all liable to occur. Around machines, wire-mesh guards on steel frames prevent hands or clothing from getting caught in moving parts. Aisles are marked off with wide strips painted white, and all materials must be kept out of these passageways.

Electric trucks are provided with horns to warn of their approach.

Hospital facilities are of the best. The hospital is located on the third floor and is entered through a waiting room. Its walls and ceilings are white and its floor is of terrazza. Cabinets containing a complete assortment of the usual surgical instruments and supplies, sterilizing equipment, and an operating table furnish the means of taking immediate care of any injured employee. A nurse is in constant attendance, and a doctor visits the plant regularly to give advice and treatment.

Many employees live too far from the plant to go home during the noon hour, and prefer not to carry lunches. A wholesome meal, however, has many advantages which should not be neglected. The possibility of getting good food, appetizingly prepared, and at a reasonable price, is always appreciated by a working force, and not only adds to their comfort but also puts them in better shape to face the tasks of the afternoon. A cafeteria, 50 by 125 ft., on the top floor provides the necessary lunching facilities in the Kelly plant. It extends across the front of the building, and is lighted on both sides by large windows of transparent glass. The kitchen is along the railroad side. The walls are attractively painted and suitable decorations are put up from time to time. The floor is terrazza. Wood tables and chairs provide seating capacity for 250 at one time.

This room is used for dances, lectures, entertainments and other social activities. A rest room adjoins it. As the plant is located within the city, where the athletic and recreational features ordinarily associated with a plant club house are available in various forms, no attempt has been made to provide such activities at the factory.

The plant was designed by Day and Zimmerman, Inc., engineers, in co-ordination with operating officials of the company, and was erected by them, the brick and some of the concrete work being done by the Turner Construction Company under sub-contract. Over a year of operation has shown it to measure up in every respect to the plans and requirements of manufacturing.

TABLE 2. SUMMARY OF DATA ON KELLY PRESS PLANT

Location	Elizabeth, N. J.
Construction	Steel and brick, fireproof, with stone trim.
Grounds	Landscape gardening in front.
Property	200 by 2300 ft.
Buildings	165 by 840 ft.
Height	Two and three stories.
Floor area	250,000 sq. ft.
Architecture	Commercial Gothic.
Neighborhood	Residential.
Employees	800 in the plant. All men in manufacturing departments.
Transportation facilities	Central Railroad of New Jersey siding along one side. Main street along opposite side.
Entrances	Middle entrance at front. Five entrances in fire towers. Side and rear entrances for auto trucks.
Windows	Steel sash. Wm. Bayley Co.
Glass	14 by 20 in. panes, transparent and ribbed. In manufacturing departments and power house it is wire-inserted.
Doors, exterior	Hollow metal. Howard, Field & Goddard.
Doors, interior	Tin-clad, with wood core, at fire exits. Hollow metal, Wm. Bayley type, between shop and office. Peelle safety doors at freight elevators.
Roof	Gypsum slab, pre-cast. Saw-tooth construction with glass on the north side.
Ventilation	Hand-operated sash in side walls. Drouve chain operators for sash in roof.
Walls	Brick, painted green inside in factory 4 ft. high and white above.
Floors, office	Concrete, covered with battleship linoleum.
Floors, plant	Jennison and Wright Kreolite wood block, set on concrete.
Ceilings	Concrete, painted white. Under side of roof and exposed portions of roof trusses also white.
Partitions	Brick, where permanent, as around fire towers, etc. Steel frame and cement plaster both sides around elevators, etc. Wood interior covered with sheet rock around factory offices, inspection rooms and engineering department, sheet metal 4 ft. high with diamond mesh wire above, for tool room, stockrooms and other storage spaces.
Stairs	Steel and concrete with Feralum tread in fire towers. Interior stairs also Feralum type. Pipe railings and concrete landings used.
Lighting	Mazda 75- and 100-watt lamps and reflectors at 10 ft. centers.
Heating	Steam generated at 100 lb. pressure and reduced through Foster adjustable regulating valves to from 5 to 10 lb. at the radiators. Johnson regulating thermostat control. United States wall type radiators. Nash vacuum pumps on return lines.
Boilers	Two 300 hp. Heine boilers for heating.
Stokers	McClave-Brooks.
Feed water pumps	Cameron reciprocating, 8 in. x 4 in. x 12 in. outside center packed.
Forced draft	Coppus blowers, used for peak loads and when fine anthracite coal is burned.
Feed water heater	Swartwout open type heater, which also purifies the water.
Boiler instruments	Regular pressure gage. Hagan combustion control system.
Stack	Brick, 150 ft. high, 7 ft. inside diameter at top.
Coal handling	Gifford-Wood track hopper, bucket elevator, storage bin and chutes. Also crusher to use when coal is frozen.
Ash handling	Frederick steam ash ejector.
Power facilities	1200 kw. sub-station with General Electric rotary converter and switchboard equipment. Also special G. E. switchboard for testing printing presses.
Compressed air	Two-stage Ingersoll-Rand air compressor, synchronous motor drive, 500 cu. ft. per min. capacity, 100 lb. per sq. in. line pressure.
Artesian well pumps	One 55 gal. and one 15 gal. Cook type pumps.
Water tanks	Two steel pressure tanks, supplied with air by a vertical compressor at 50 lb. per sq. in.
Motors	Drive motors for line shafting 30 hp. 60 cycle, 3 phase, A. C. General Electric.
Direct-drive control	Monitor Controller Co. type used on planers.
Shaft bearings	Fafnir ball-bearings.
Chain drive	Used at short centers. Morse and Whitney chains employed.
Cranes and hoists	Six 1-ton cranes, six 2-ton cranes, one 3-ton crane, two 1-ton hoists, two 2-ton hoists and three 3-ton hoists, used for handling materials and assembling work. All Shepard Electric.
Electric trucks	Three Elwell-Parker lift trucks and one crane truck used.
Lift trucks	Four Jackson, 6 Steubing, 6 Lewis-Shepard.
Elevators	Two 6000 lb. and two 8000 lb. A. B. See freight elevators and one passenger elevator with Tyler trim, doors and car.
Dust and fume collectors	B. F. Sturtevant. One for painting department and one for castings cleaning room.
Sand blast	Sly sand blast equipment used.
Sprinklers	Esty system installed in the shipping, painting and wood working departments.
Fire extinguishers	Foamite-Childs and Pyrene installed in all departments.
Fire hose	17 folder bracket type installations at accessible points around the plant.
Fire alarms	25 city alarm boxes in various locations.
Watchmen's system	American District Telegraph Co.
Storage shelving and racks	Steel, painted dark green, Durand.
Factory stools	Steel frames, wood seats.
Blinds	Used in office only. Rolling slat type.
Safeguards	For machines, steel frames covered with wire mesh, assembled at plant. For aisles, white paint markings to guide traffic. Electric trucks have horns.
Hot water heater	Sims boiler; gas heaters installed in connection with the hot water heater, from American Heating Company.
Wash bowls and closets	White porcelain, Crane Co. and Douglas.
Toilet partitions	Weisteel.
Shower partitions	Alberene stone.
Shower heads and control valves	Crane Co.
Drinking fountains	Pedestal type, white porcelain, Crane Co.
Plant communication	Telephone, through central switchboard, also connected with the outside.
Time system	Periodograph system for in and out records. Periodograph system for time on jobs.
Hospital equipment	Metal type, sanitary construction.
First aid equipment	Metal cabinets.
Cafeteria equipment	Waldorf steam table. Wood tables and chairs. Full complement of dishes, silverware, etc., for 250 people. Vulcan gas ranges in kitchen.

Making a Success of the Small Manufacturing Business

I—How to Get Through Early Stages

By C. U. CARPENTER

YOU can't dodge a fact, you who are starting a small manufacturing business. I don't believe that most enterprises fail because of lack of working capital, as we are so often told by Dun's and Bradstreet's. My experience shows that the greater part of the failures is due to the fact that you—like every mortal—simply insist on believing what you like to believe, regardless of the facts.

You can't dodge a fact. Try it, and it will come back at you later and deliver a blow that will ruin your plans. Instead, look it right in the face; be thankful that you are able to recognize it. Then get every energy to work and whip it.

Unfounded Belief in Product

I've seen many an enterprise fail because the inventor insisted on believing that his product was right when it would not stand up under market conditions. It was his baby; it simply couldn't have the measles or scarlet fever. It worked all right when *he* operated it. The public delivered its opinion by sending back the machines about as fast as they were shipped. Finally the concern gave up the ghost because the money ran out. Lack of working capital? No; lack of willingness to face facts and meet the issues.

Or, here comes a concern that brings out something that is seemingly a copy of your article and, through superior selling ability or larger capital, drives you out of the market. Your patent suit fails, and I can hear you talk for years after about our outrageous patent system that permits a concern to steal your ideas.

You simply will not recognize the fact that you cannot patent an idea, but you can patent every conceivable way of making that idea effective. You ordinarily try to patent the best way of accomplishing your plan and leave the door wide open for a dozen other ways. Your competitor, with his superior selling plans, will drive you out of the market even though he may have a more costly article to manufacture.

Or, after you have got a good start, and are getting along swimmingly, along comes a concern that stops you with a patent claim on a feature that is relatively unimportant. It takes large sums out of your pocketbook—and makes you change your mechanism, with attendant delays and loss of markets, and at a cost that sinks your ship about four times out of five.

Again you shout to high heaven about our government granting you a patent that is "no good." Again you fail to face the fact that our government won't and indeed can't, guarantee all patent claims. If they ever tried it, the cost of getting a patent would be staggering.

It's distinctly up to you to make your own patent search and survey and find out yourself if your invention infringes. If you haven't the money to have this done thoroughly by a good patent attorney, do it yourself as I describe in the October issue under the heading "Patents." Later have a competent patent attorney make the search.

And so it goes. Your selling plans may be wrong. It may cost you too much to get on the market, and too much to stay there. Your factory may cost you too much and absorb all of your ready money. There is a modern shop, perfect in every detail, standing idle in a town 40 miles from where I write, that took every cent of capital that was raised to build it. When it was all ready to start, they had no money to operate it. They had a fine time bragging about that great shop that was going to do such wonders, but they collapsed like a bag of wind when they realized that they could go no further. It's being done every day.

You may find, after you start to market, that your competitors have really a superior article that the public prefers. You may have been so wrapped up in your little pet that you would not look frankly at competition. You will learn your lesson when you try to enter the markets.

There are many ways in which you can deceive yourself, any one of which will knock your plans "into a cocked hat" and cause you great losses, all of which could have been avoided if you had made careful surveys and looked old Mr. Fact right in the face, met him and conquered him.

Danger in Believing What You Like to Believe

This isn't theory on my part. In my time I've been one of the best little "believers in what I liked to believe" that you could find. I had my pets and they simply couldn't go wrong. But old Mr. Fact would turn up sooner or later (usually later, to my sorrow) and deliver a blow that would knock the breath out of me. And I can still remember the hours and hours of hard work and worry that mounted up behind and ahead of me in order to overcome difficulties that I should have foreseen if I had sat down and thought the whole thing through frankly and recognized the

facts in the case. It is surprising to note the number of cases of failure or near-failure that can be attributed to failure to think the entire problem through and face the facts.

You may think that my methods of analyzing the different situations that confront a man who is starting a business involve too much detail and time. However, remember that your enterprise will stretch over a long term of years, and therefore it is exceedingly important that you cover every branch of it in your searches and surveys, for otherwise something may arise that will utterly destroy the plans you have spent years in developing. This has happened thousands of times to others. It may to you. Insure yourself and the ones that invest with you by making these surveys before you go too far.

The subjects covered by the surveys are:

1. *Your Product.* Consideration of your design; determination of costs (factory, sales, executive); preparation of production program; consideration of design with relation to quality and durability, and with relation to salability against competitor's product; methods of testing (apart from factory tests) to insure that the product will satisfy the customer's requirements for quality and durability and will stay out after it is shipped; proper method of calculating your requirements for equipment, tooling, etc., and the capital needed for this part of the investment.
2. *Selling.* Study of the markets suitable for your product; determination of the method of selling that should be used; cost of selling and tie-up of working capital; methods of home office management that will bring proper selling pressure upon your field forces, whatever they may be; the importance of keeping your sales program within the limits of your productive capacity and especially within your working capital limits.
3. *Advertising.* Methods and sources to be used; keeping your advertising within the limits imposed by productive capacity and capital limits; setting limits on advertising.
4. *Patents.* Importance of determining how much of the field is covered by your patent; the patent search and survey to determine whether you are infringing; future development.
5. *Capital.* Capital structure; capital needs for fixed assets, stores and work in process of manufacture; liquid capital necessary; necessity of care to prevent your sales and manufacturing plans for increase getting ahead of your capital limits; consideration of state taxes; figuring profits too high; inventor demanding too large a share of stock; raising the money needed.
6. *Expansion.* Need for care in expanding into new and possibly unprofitable markets; study of manufacturing, selling, capital, and organization problems before expanding.

The usual method of developing the design of your proposed product is to work it out so that the result desired will be accomplished. Little attention is given to other considerations, yet questions that are vital should be constantly considered as the design develops, questions that may ultimately determine the success or failure of your enterprise—questions that are not important as concerns the workability of the product at all.

Design has a direct and vital effect upon cost of production, and tooling. This will be granted immediately; but the case is not so clear when we state that the design has a vital effect upon the cost and resistance of selling.

In many cases the cost of selling is more than the cost of producing and anything that may reduce this selling cost is of real importance to the company and the designer. How can the design affect and reduce the sales cost? Simply by making the design and consequently the product so attractive to the buying public that it will sell more readily and with less selling effort—or, reduce sales resistance.

At this point we bump up against the fact that 9 out of 10 inventors really believe that when their pet gets on the market, the public will demand it; that very little effort will be needed to market it. They will quote to you that saying about the mouse trap in the woods: If it were the best mouse trap, the world would beat a track to the door. If Mr. Emerson had been a modern business man he would have known that this mouse trap would have needed advertising both local and national—sales effort with specialty men to convince the buyer that he *needed* a mouse trap—arguments why mice should be eliminated—talks on the merits of the different makes of mouse traps—pressing arguments as to why he should pay you more for your fine mouse trap than Bill Smith charged—to be finally squashed by his statement that he was going to get a cat and didn't need it anyhow. Then the home office wants a statement explaining why Jones did not buy your trap, with records made of your report, calling for you to call upon Jones the next time you're there because his cat might be dead by that time or grown too fat and lazy to catch mice.

Try to Sell Your Own Product

Mr. Inventor, don't you believe it! The Americans do not like to part with their money unless it is something that adds to their pleasure. If you want to face some real facts, just you take your machine under your arm and go out to sell it yourself. You will be speedily cured of your illusions about the great ease of selling anything that is new.

It is a real job to sell a new product and the more advantages or "talking points" that you can put on it the easier and less costly it is to sell.

Start out by getting samples of your competitors' products. If you cannot afford to buy them, examine them carefully. Be both critical and *honest.* If they have advantages that your product does not possess, acknowledge them and then determine, with your sales advisor, whether or not they are really needed, and, if so, whether you can incorporate them in your design. The more "talking points" your product possesses, the more money you will save in selling and the quicker

you will be able to get your product on the market.

I once procured my competitor's product, placed beside it my own, then called in my salesmen and factory heads. I told them I wanted an honest comparison—no bouquets—the good points would take care of themselves. I offered $5 for every point brought out showing my competitor's superiority. When we got through I had a headache and plenty to think about. But when I finished revamping my product to meet these objections, I had one that walked right off on the market and which sold with surprising ease and low cost. But before I tried this disconcerting plan, no one could have told me that my product was so incomplete. That is what I call hunting for the unpleasant facts and looking them right in the face. Did it pay? I should say it did.

Once your chief designer gets this idea in his mind and realizes the importance of such considerations, he soon becomes greatly interested, and the beneficial effects are reflected in your products.

Effect on Costs

The direct effects of design upon costs are apparent, yet many designers seem to forget this item. Of course your production costs affect the success of the enterprise directly. The designer affects the cost of manufacture more than any other single man.

He should consider each and every part and see that its design will result in the lowest possible production cost. His design will determine the sequence of operations, the type of machines required, and the actual time of production. We must always remember that total costs are made up of a multitude of small costs, and that the only way to keep costs down is to study each and every part and keep its cost down. This involves a lot of study and work, but it's the only way. The results make it well worth while.

I have always got my factory superintendent and designer together to work out these problems. However, the men occupying these two positions usually get along about as well as two strange bull dogs and sometimes that enmity prevents proper consideration of your problems. It can usually be lessened by skilful handling.

When considering this problem I also call in the foreman of the job upon which the work will be done and his advice is often invaluable.

Assembling. There is no study more profitable than that of assembling. Strangely enough, we usually spend much time in studying ways and means of saving on machining operations and leave the assembling to take care of itself. There is a much greater field for saving here than anywhere else and the study of ways and means to assemble cheaply ought to begin at the drafting table. The main methods ought to be worked out here instead of being left to the assembling foreman to work out later.

The complete assembly of units, complete in themselves, will usually be the best method, as will be described in detail under the section on Factory.[1] This must start with the designer and he ought to keep it in mind in every part of the design.

Tooling. The same careful consideration must be given your special tooling, not only for its effect upon the quality of tooling and the mechanical results secured therefrom, but also for the effect upon tooling costs. The design and shape of a part has much to do with the cost of the punch and die or form tool or drill jig that produces it. Surprising savings in tooling costs can be made by giving this subject careful thought. Pretty little curves look fine on the drawings, but how they do cost on the tooling! Stick to straight lines and true radii when you can.

Ease of Repairs

A very important item to develop is making repairs an easy matter. Usually this is subordinated to the making of the main design to such an extent that parts subject to the principal strains and wear are hidden in inaccessible places. This has a startling effect on the business in ways seldom suspected.

Let's see what it does to the sales department. First, it makes repairing an expert mechanic' job. Of course this adds greatly to the expenses. But the most serious side of it is that it even may make it necessary to adopt the expensive "company branch" system of selling in order that the company may supervise its repairs. If the repairs are difficult, then the dealer system of distribution sometimes cannot be adopted.

I know of two cases now where the companies are forced to maintain their own repair offices because of this condition, and they can see, week by week, smaller competitors creeping up on them because these competitive machines are so simple to repair that the newer companies are using the "dealer" system of selling and hence are under a much smaller selling expense. Of course, where they maintain repair offices they naturally sell through their own branch houses.

The idea of design affecting the selling system never occurs to the designer, yet it does to a great degree.

Then, too, frequent and costly repairs affect the customers unfavorably. The customer is always annoyed at interruption of service. He has his system geared up, with the device a part of it, and resents greatly any break in it. The factory may say, "Oh well, that's not a serious matter," but it is to Mr. Customer, and his voice is soon heard crying out against the product that interferes with his progress. And it's the little things that count in the long run with both selling department and factory.

Effect of Shipping

Here is a subject that *does* deserve attention. It seldom gets it. The inventor and designer produce a product that works perfectly in the shop. This seems to satisfy them. The start is made and it is shipped away. By the time the product arrives at St. Louis or Seattle it is more or less a wreck, requiring a thorough going-over by experts. Why is this? Try a shipment to distant points, having it returned with packing intact.

[1] In the October issue.

The jar and movement of the freight car becomes rhythmical and then the screws and nuts begin to back off. The looser the mechanism becomes, the worse the condition. Here again comes expense and the necessity of company supervision of service.

Portability. Of late there has crept in a craze for "portability." Fine idea where this is a real need, but I seem to see it spreading to classes of product where portability is not an important factor.

The arguments are that the product is so light that it may be carried from point to point by the operator without effort. The maker himself is influenced by the saving in material costs. He often overlooks the fact that the extra difficulty and cost of making and handling small parts overbalances these savings.

To my mind, the chief requirement (next to perfect performance) is durability. And you cannot afford to sacrifice durability and strength to "ease of carrying around." If you can get both, then very fine. Just recently there came to light a case where a manufacturer of a complicated product became enamored of the portability idea and built a light model at great expense for tooling, only to find that it would not stand the shipping strains and public roughness, and lost out with damage to his reputation that affected the sale of his old time-tried line.

A word of warning: Before you adopt the "portability" slogan, be sure that the savings are real; that there is a real public demand for this feature in your product; and that the light machine will "stand the gaff" of both shipping and public service.

Mr. Designer, do not neglect this point. It is of great importance to every branch of your company. Your careful design affects every development of the business. Even if the company starts off with a clear field, five years from now there may be a different story to tell when the field is full of competitors.

Personally, I feel very strongly about the importance of design. It affects each and every branch of the business. It gives the start to everything and hence its development should be watched with great care, keeping in mind:

Excellence of product
Talking points to aid sales
Cost of production, especially assembling
Cost of tooling
Ease of repairs
Effect of shipping.

Tests Preliminary to Manufacture

I do not care how broad-minded the inventor, he does hate to see his invention manhandled and treated roughly. His approach to it is through his pride in its development. Each part means something to him. He knows that it will work properly if it is operated correctly. In spite of himself, he will favor it in any tests that he may make on it.

But how about Mr. Public? He approaches this cherished invention from the standpoint of service. He cares nothing about its wonderful mechanism. The question is: "Can Sallie Jones, who is probably not in favor of using the device, and who will put it through its paces, get out of it what the salesman claimed?" Then there is always that cheerful group that gathers around the inventor's pet at the noon hour to make an intensive study of ways and means to "beat" the machine, or see if it will "stand the gaff." That product will get tests that the factory experts never dreamed in their wildest moments.

Now here comes that old story about "facing the facts." There never was a factory force yet that, when the product is returned with parts awry from rough treatment, would not minimize these conditions. "Oh, yes, we can overcome that," is their statement. I know, because I used to say that myself when in my heart I wondered if I could ever get the darned thing to go again.

Now, why not sit down and use your head and say, "Well, if that's the way the market is going to treat this product, let's get busy and correct the faults." You have got to do it sooner or later. *Face the facts,* and do not make another move until the defects are overcome.

The Howling Stockholder

"Fine, good sense!" you will say. But there are a lot of influences and motives hidden away where you can't see them that are, in fact, the real impelling forces in most enterprises. The inventor and the production man are not the only ones at fault. There is another influence that is very strong.

Old Mr. Stockholder appears upon the scene and lets his voice be heard in no uncertain tones: "When I put my good money in your business you told me that we would be getting out machines by January 15th, and here it is the end of May and no machines are on the market yet. Where are they? And you keep on coming to me for more money, too. I won't put in another cent, nor will I let my friends, until I see you shipping machines." Now, Mr. Theorizer, what are you going to do in such a case?

The head officials, worried over where the next payrolls are coming from, run down in the shop and have a warm conference with the superintendent. Out go the machines and the stockholders are happy until the backward procession begins and machines are returned, with irreparable damage done to the selling plans. It takes years for a firm to overcome that first bad reputation caused by defective machines. There can be no worse mistake than to ship machines before they are tested under market conditions and you know that they will *stay out* when they go out.

I'll confess that it's pretty hard to advise you how to handle the "howling stockholder." Of course, he should not have been told that the machines would be on the market by January 15th. But the men who raised the money and persuaded him to invest probably believed it and could not foresee the many delays incident to starting a new business.

My thought is that it pays better to start in a small way and develop slowly, keeping your investors fully advised on progress and giving them facts.

(To be continued in the October issue.)

Executive Control of Power Economy

Ways and Means to Lowest Operating Cost

By WALTER N. POLAKOV

Consulting Engineer

WHAT an executive wants to know regarding the power department is whether the operation is as economical as possible, and if not, why not. To answer these questions intelligently he should know:

What is the lowest possible unit cost? (1)

Due to the fact that the efficiency (coal and steam consumption per unit of output) depends on (a) the rate of the load carried, and (b) the adjustment of operating conditions, it is necessary to establish first:

What is the best efficiency of equipment? (2)

Then translate these data into dollars and cents from the knowledge of:

What is the cost of labor and materials? (3)

In other words, the lowest possible operating cost (1) is the result of an interplay of operating conditions (2) and market prices (3).

Obviously enough, a busy executive cannot afford time to analyze the mass of variable data reported daily. What is necessary and sufficient for him is to see, at a glance in a simple chart form, how much the actual cost is above the predetermined (Fig. 1), and if the excess is large, how far the performance is below the task (Fig. 2).

If the fuel utilization chart shows that the task was lived up to, the excess of actual cost over the predetermined[1] is evidently due to higher prices paid for fuel, supplies or labor, and the executive turns his attention in this direction.

If the fuel utilization chart shows that the performance is falling short of the task set, he studies the symbolic letters at the end of each short bar, which denote the reasons of poor performance, such as:

g—Green operator.
r—Repairs needed.
f—Fuel causes trouble.
l—Load fluctuates or is unfavorable.
m—Man inattentive, indisposed, etc.

In this case he may call the operating engineer in conference to decide on a plan of action.

The success of the executive control depends on the accuracy of the information available. The preparation of these two digested summaries is therefore of great importance.

Determination of the best performance that can be expected from a given equipment requires considerable experimentation, at the end of which all influencing conditions are standardized and their relations defined. To illustrate: A series of such study tests was made on the Badenhausen boilers installed in a New England mill, using fuel oil atomized by steam, through 4 Hammel burners. The tests covered a range of from 95 to 186 per cent rated load (25,000 lb. per hour = 100 per cent rating). It was then found that up to 180 per cent of load a uniform evaporative efficiency of 85 per cent can be maintained (including economizers). After this point the efficiency begins to drop rapidly. To maintain this efficiency, a certain relation between furnace draft and uptake draft should be maintained, at which the adequate volume of air is drawn into the furnace to secure both complete combustion and a proper velocity of hot gases in contact with the heating surface. Under the conditions as plotted in Fig. 3, the CO_2 in the flue gas remained between 14 and 14.6 per cent and the efficiency was uniformly 85.5 per cent.

Basis of Instructing Firemen

Such information is made the basis for instructing the firemen. Draft gages are then marked to correspond with the steam flow, so that for any rate of flow the draft in furnace and in uptake must be at a definite point. The author has been using this method of directing firemen since 1911, and publicity given to such instrument arrangement made for the Penn Central Light and Power Company[2] resulted in the commercial combination of differential draft gages and steam flow meters in one instrument.

The records of wrong adjustment of conditions, as may be seen in Fig. 3, prove that any inattention to predetermined standards causes loss. Even slight deviations result in 4.15 per cent loss of fuel (on an annual basis in this case equivalent to a waste of over $10,000).

The actual improvement in this plant from former average efficiency of 76.5 to 85.5 per cent, while the smallest percentage in my experience, resulted in annual savings of over $30,000 in the fuel bill.

[1] "Standardization of Power Plant Operating Cost," Trans. A. S. M. E., Vol. 38, 1916.

[2] Trans. A. S. M. E., 1913, paper 1401.

Similarly, tests on the water rate of steam turbines, engines, etc., will establish at the given steam pressure, superheat and vacuum, the required number of pounds of steam per kw-hr. at different loads. Loading prime movers below or above the lowest region of steam consumption will, of course, result in excessive consumption and higher operating cost.

Having thus established the best performance that can be expected from the existing equipment at different loads, we have definite values for the whole range of variations of power output.

Thus, if the evaporation per pound of fuel oil is 15 lb. of steam, and the turbine at full load consumes 15 lb. of steam per kw-hr., then 1 lb. of fuel generates 1 kw-hr.; and if, with 50 per cent load, steam consumption per kw-hr. is 20 lb., the fuel consumption per kw-hr. will be 1.33 lb., etc. While the excellence of performance remains the same, the operating economy is reduced with the reduced output even though the efficiency of attendance remains the same.

Comparison of results with the standard set is best presented by the straight line chart developed by the author in 1910 and generally known as the "fuel utilization chart" (Fig. 2). For each day and for each shift a space is provided, the length of which represents the task attainment (say, 10 lb. of steam per pound of coal). The length of the record bars drawn each day opposite each man or shift represents their actual accomplishment (say 9 lb. evaporated per pound of coal). Daily and weekly averages are similarly drawn. In this manner the executive sees how well the plant is operated, or how far the men fall behind their tasks.

The same type of chart is equally well adapted for recording turbine or engine room performance (by showing pounds of steam used per kw-hr. generated, as this is influenced by proper distribution of load among the units), or even of the entire power plant, (by showing number of B. t. u. used per kw-hr. produced as against the standard set, say 20,800 B. t. u. per kw-hr.), or of task by repair gang, yard crew, etc.

Comparison can be made between corresponding periods of consecutive years (see Fig. 2).

With the aid of this graphic record showing who attained (or exceeded) the task and when it was attained as well as who fell short of it, with the time and reason, the executive can keep himself informed at a glance at his desk whether power generation is as efficient as it can be, and if not, why not.

His next problem is to have these operating data presented as items of expense. To translate the required amount of fuel and steam at best performance into dollars and cents is a matter of simple multiplication by the prices of fuel and water. The distribution of labor to each unit of output (1000 lb. of steam or kw-hr.), is more complicated, because while coal and water, and often supplies, vary directly with the load and efficiency, the pay-roll remains constant within certain limits of output. Reduction of or addition to the operating force takes place from time to time as the bulk of the business and conditions change.

Predetermination of power cost resolves then into

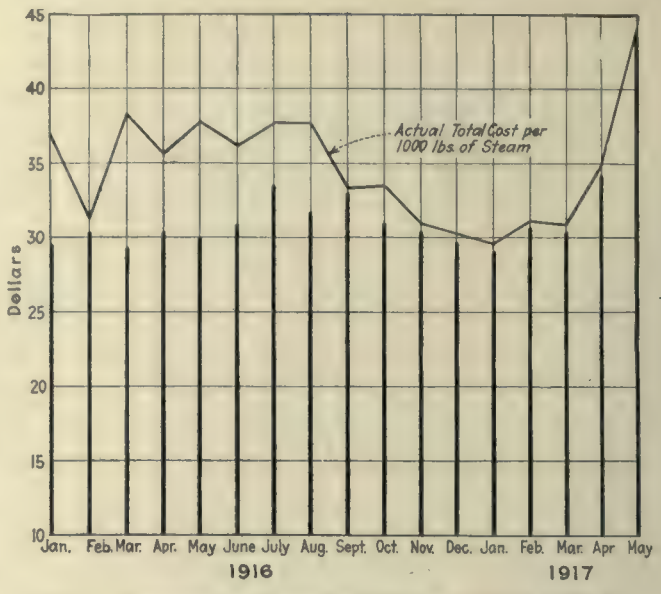


FIG. 1 PROGRESS IN APPROXIMATION OF ACTUAL COST OF STEAM TO STANDARD

(Based on various monthly outputs and coal prices)

The vertical bars indicate the standard cost of 1000 lb. of steam, or what the product should cost, considering price of coal, labor and supplies and the monthly output at best practically obtainable efficiency. The distance between actual cost curve and the top of the bar is a measure of preventable loss. If the actual cost curve crosses a bar, it means that some improvements were introduced or charges were reduced. In such a case standard must be revised according to new conditions.

a set of data for any given market price, somewhat as:

LOAD	COAL ALLOWED	DOLLARS COAL	SUPPLIES	LABOR	TOTAL OPERATION	OVERHEAD	GRAND TOTAL	UNIT COST (per kw-hr. or M. lb.)
1000								
2000								
3000								

A diagram similar to Fig. 4 can now be readily prepared, from which the accountant finds what should be the ideal or standard cost at any given load or output, provided the task is lived up to in the power department.

Comparison of actual operating cost with this predetermined or "bogey" cost can easily be made. To represent it graphically is desirable and advantageous since, even with the same degree of operating excellence, the unit cost may be higher or lower, depending on the bulk of the output, while again, at larger output, low cost may mean worse operating performance than higher cost at a smaller output.

The most practical way for the executive is to get his cost reports prepared for him so that they are accompanied by a diagram similar to Fig. 1. No executive can keep such relations in mind. Hence, without such a graph he can never get true perspective on cost fluctuations. In this manner one can see how far the curve of the actual cost is above the standard operating cost shown by the vertical bars. Care, of course, should be taken not to adulterate the operating costs by repair and maintenance bills which are irregular and, when the level of wages or the prices of fuel change, the standard costs should be revised accordingly.

Thus far the analysis of variables is simple. Different loads require definite, different adjustment of operating conditions. Inherent efficiency of equipment once studied and determined experimentally may be considered as constant. Variations of prices for labor, fuel and supplies may also be taken for any given period as constant and values are revised every time market changes necessitate doing so.

Now, the problem before an executive is to see that the work is done as efficiently and as cheaply as possible within the existing limitations. This obviously depends upon the "human differential," or that element which controls the conditions which are necessary and sufficient for securing the minimum cost of production.

To direct this process of minimizing the operating expense requires much more than mere familiarity with power machinery and physics involved in the processes. Such details may be safely delegated to operating engineers. Yet the establishment of tasks and standard costs invariably demonstrate that the actual, day-in-and-day-out performance is below what it is possible to attain. And this meagreness of results is due to the fact that it is not enough to provide men with knowledge; it is equally important to provide them also with the desire to use it properly.

Human Differential

The actual betterment work depends on many factors; man in industry is very complex and should be regarded as a whole and as he is. Any attempt to consider only one or a few sides of the situation is a chance undertaking, since it does not take into account the inter-relation with other factors. It is also true that any increment, even very small, in life as in calculus, affects the function. Another pitfall is approaching the man in industry with preconceived ideas as to his mentality, ethics, social relations, etc., which, being either true or false, create an artificial atmosphere, where one fights largely against windmills.

A few notes from experience serve to illustrate this "human differential" in power economy.

1. *Personal Factor.* Installations of indicating and recording instruments in a New Jersey factory power plant created rumors prompted by the fear that "the boss wants to spy on the men," and that "many will be fired." Instruments on alternate boilers were covered up and at the end of each shift they were opened, calculations were made, and the firemen were shown that, on the boilers with the instruments in plain view for their guidance, they made 8 to 10 per cent better evaporation. This convinced the men that since they thus do better work for the employer, their jobs are indeed more secure than before. A favorable attitude was quickly established and efficient habits of industry became well rooted.
2. *Sense of Justice.* In a New England paper mill, a bonus was paid to the firemen for attaining or exceeding the task (50 cents a man-shift on 72 per cent efficiency). Seventy-two and five-tenths per cent average efficiency was attained and maintained for several weeks. On October 1, the bonus was cut to 30 cents by administrative order. Efficiency dropped to an average of 66 per cent. On January 1 the old rate was re-established. Efficiency at once rose to 72.3 per cent and remained near this average for years afterward.
3. *Sporting Spirit.* In a surgical gauze and cotton mill, economic results were fluctuating widely even after prolonged training of the men. A blackboard was placed in the boiler room next to the instrument board and daily the scores of each shift were posted. Uniformity of results was quickly attained and many years afterward the management reports uniformly high evaporation.

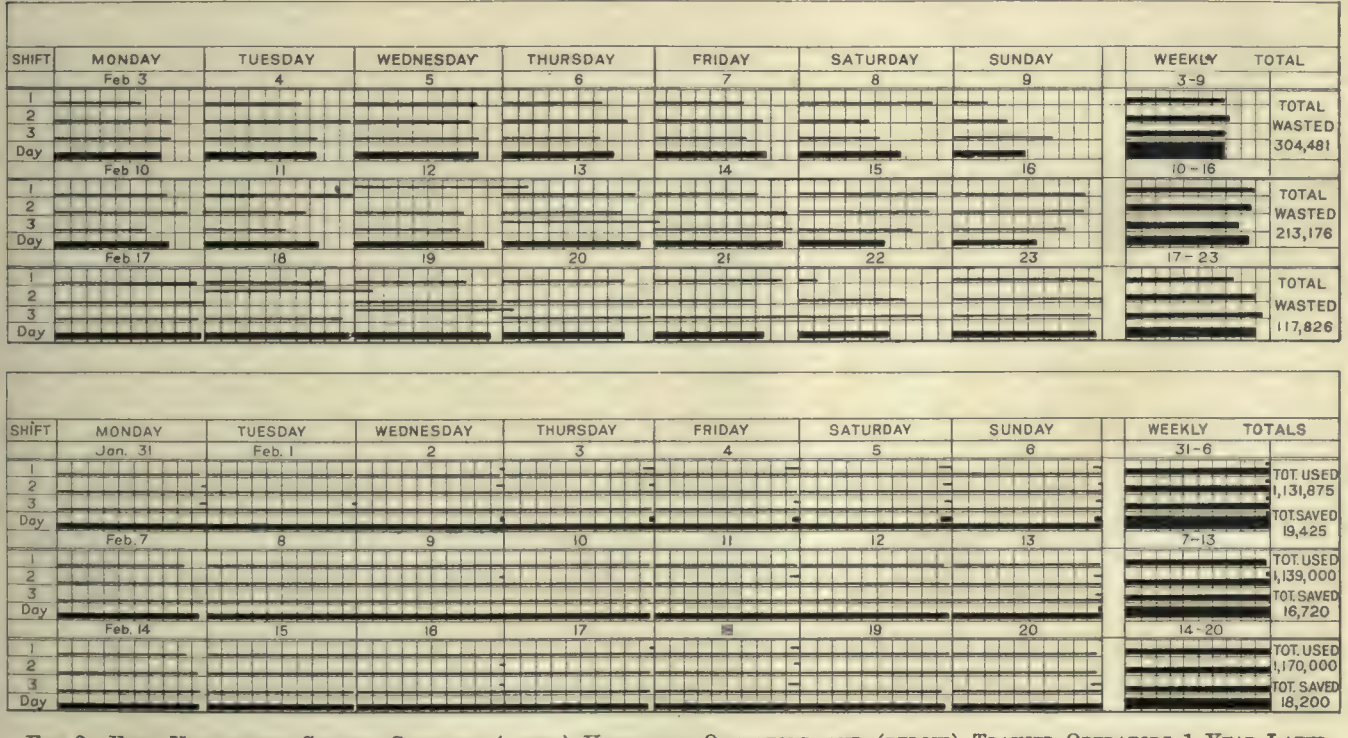


FIG. 2 FUEL UTILIZATION CHARTS, SHOWING (ABOVE) UNTRAINED OPERATORS, AND (BELOW) TRAINED OPERATORS 1 YEAR LATER

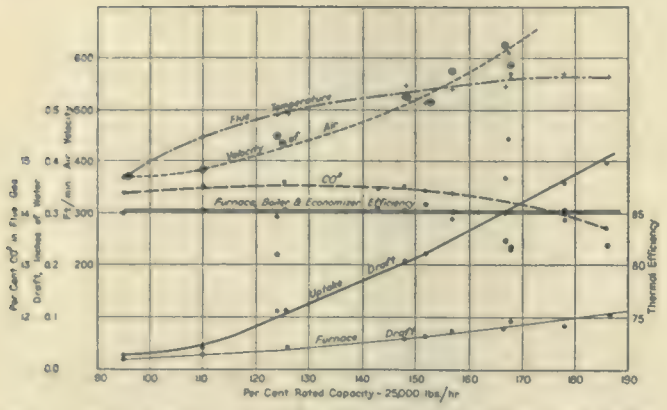


FIG. 3 STUDY TESTS OF THE BADENHAUSEN BOILER, OIL FIRED, 4 HAMMEL BURNERS, BACK SHOT

4. *Physical Discomfort.* Working conditions in a rubber factory power plant were unsatisfactory. Turnover was excessively high and only men of low grade were available. Physical improvements, such as introduction of seats, elimination of noise, dust and excessive heat and cold draft in winter, reduced turnover to an unappreciable minimum; men acquired skill; and economy of operation was greatly enhanced.
5. *Training.* In a public utility plant, the firemen were trained and a uniform average efficiency in excess of 70 per cent was maintained for years. Stokers were installed, but no new standard practice was developed, and men left untrained. Efficiency dropped to 52.3 per cent and even eight months after it was only 64.2 per cent.
6. *Social Factor.* In a factory boiler room, training of men was started and gradual elimination of preventable waste of coal reported weekly as follows: First week, 23.3 per cent; second week, 9.4 per cent; third week, 5.4 per cent; fourth week, trouble in the press room threatened a strike and the firemen were interested in the situation; consequently, waste of operation increased to 9.2 per cent. Factory difficulties were settled quickly and progress in the elimination of boiler room waste continued after the setback; fifth week, 7.1 per cent; sixth week, 5 per cent; seventh week showed that the task was exceeded, and a saving of 12 per cent secured.

The elimination or reduction of power plant losses does not involve remodelling the plant, investing in new generating equipment, nor interference with operation and service. The means to save what is now going to waste are wholly within the reach of the executive control. This, again, does not imply that the executive should familiarize himself with the intricacies of chemistry of combustion, thermodynamics and whatnot in power engineering. An executive of modern industry can no longer be a "Jack of all trades" and any attempt at pretentions to "know it all" is sure to meet its Waterloo.

To establish a reliable method of executive control requires some expert study and, here and there, a few measuring devices. Generally speaking, the course of procedure starts with the determination of possibilities offered by the existing *non-human or material factors* (such as fuel, boilers, engines, generators and other machinery and supplies) and winds up with *the human factor* (such as selection of employees, their training, hygiene, mental stimulus, and economic incentive, etc.). This human factor proves in every case the determining factor of plant economy. Whether the equipment with which the personnel has to deal is perfect or imperfect, the inherent efficiency of the mechanism can be fully realized only when:

1. Process is clearly understood (i.e., men are trained).
2. Relation between conditions is observed (attention is maintained).
3. Desire to do correct adjustments is stimulated (will is stimulated).

Intelligence, observation and will (i.e., knowledge, psychology, and biology) thus come into the domain of engineering on a par with calculus, physics and chemistry. To neglect any phase of the whole problem[3] is not only absurd but the shortest way to failure as well. This fact, recognized by forward-looking, successful executives, is clearly stated in the report of the Committee on Engineering of the United Typothetæ of America: "The interest of industrial leaders today is shifting from the material to the human; from things worked with to the workers; from the machinery of industry to the man who makes, owns and operates machinery."

It is such an approach to the problem of elimination of fuel and steam losses that offers most promising results to the executive, with the least expenditure of time and money. And it is this field in which no one can claim that his plant is an exception.

[3] In "Mastering Power Production" the engineering problem as a whole is presented for the first time (1918).

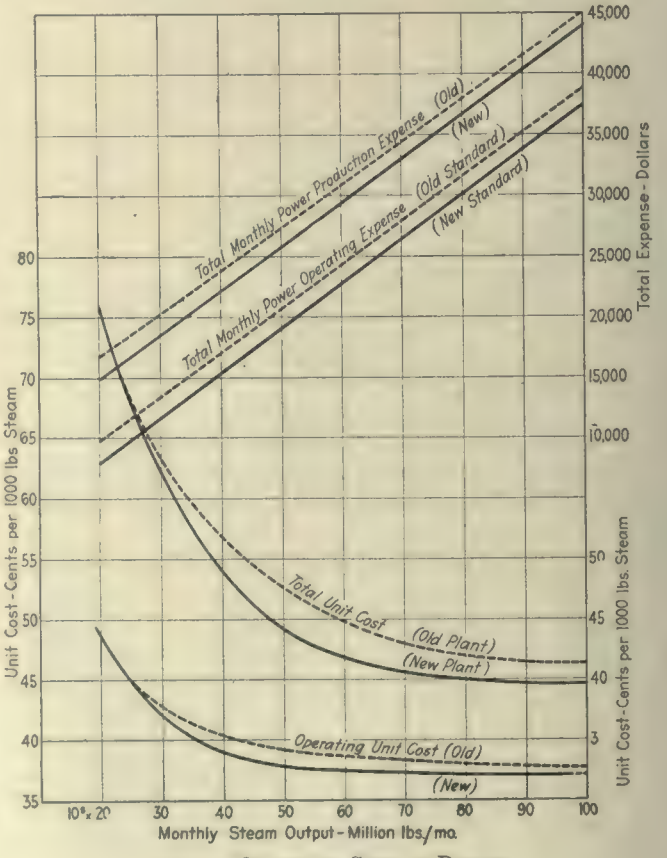

Total Monthly Power Production Expense (Old)
(New)
Total Monthly Power Operating Expense (Old Standard)
(New Standard)
Total Unit Cost (Old Plant)
(New Plant)
Operating Unit Cost (Old)
(New)
Unit Cost - Cents per 1000 lbs Steam
Total Expense - Dollars
Unit Cost - Cents per 1000 lbs. Steam
Monthly Steam Output - Million lbs/mo.

FIG. 4 STANDARD COST OF POWER

Bell Telephone System Budget Plans

Provide Working Basis for Co-ordinating Activities in the Light of Past Experience and Careful and Logical Plans for the Future

By C. A. HEISS

Comptroller, American Telephone and Telegraph Company

THE pages of history tell us of many ways by which mankind has sought to foresee and appraise the future. Soothsayers and astrologers, sibyls and oracles, all were held in high esteem in the life of their times. The bases for prophecies were many and varied; dreams, the position of the stars, the bones of lambs, nature's marking on stones, and many other things quite as irrelevant were all used. With the advance of knowledge and lessons from experience, men have discarded these methods of appraising the future. They have also learned that guesses or "hunches" are unreliable guides and that the best assurance toward a successful future lies in the careful planning for it—by studying what has happened in the past and, in the light of experience, surveying the problems and possibilities of the future so far as they may reasonably be foreseen.

The Bell System management has the task of furnishing efficient national telephone service, utilizing an investment of almost $2,500,000,000. An indispensable factor in meeting this responsibility is a continuous scientific budget to give a complete summary of past and forecast construction, operating and financial facts. Its accuracy is shown by the experience of 1924: Gross additions to plant exceeded the estimate by less than 5%; total telephone revenues and expenses, respectively, varied less than 1% from estimates.

The wisdom of this course is universally recognized; from it governments hope to realize a partial solution of their present-day fiscal problems; modern business enterprises find in it a more scientific and safe way of directing their affairs; and even the twentieth century housewife finds it an excellent way to insure an abundance of "pin money" and to promote domestic happiness. Manifestly, other things being equal, the greater success and satisfaction will be realized by those who intelligently and carefully plan their future course.

Modern business in particular has, by experience, come to realize the value of recording, classifying and analyzing its problems, performance and potentialities in order to learn, if possible, what it may expect for the years which are to come. To this end, carefully adapted methods of accounting and statistics have been developed to record the past and point to the future. By analysis of these the executive finds an indispensable aid in forming his judgments and intelligently directing his undertakings. Doubtless, many business failures of the past might have been avoided if adequate budget plans supported by sound and dependable statistics had been available to the responsible executives.

The companies comprising the Bell Telephone System—the American Telephone and Telegraph Company and its 25 associated companies, each of which is a separate corporation owning and operating the telephone plant serving its own particular territory—have for many years followed a budget plan. From simple beginnings this plan has developed along with the growth of the business, until it has become one of the indispensable adjuncts to successful administration and operation. It provides not only a working basis for the co-ordination of the activities of the various operating divisions within each company but also for the companies within the System.

The budget plan in use by the Bell System companies is a complete statistical summary of construction, operating and financial facts, both as they are presented by a pertinent period of past performance and as they may be forecast for a reasonable future period. It begins with an analysis of past experience and, in the light of that, searches the future and makes orderly preparation to move upon it. Those who administer the business have available a comprehensive picture of the growing and changing character of the business for the purpose of reaching well balanced judgments as to the lines of development necessary to meet the public needs and as to the best administrative policies and practices to be followed. In the beginning these budget plans were confined principally to a survey of the situation for one year in advance, set up in comparison with the realized performance of the present and past. To obtain a better appreciation, however, of the effects of general industrial and economic conditions upon the demand for telephone service and the requirements involved in these demands, it was found necessary to look into the future beyond the next year or two, so that the task of rendering telephone service could be better visualized, and its problems anticipated and provided for most intelligently in advance. To this end, the Bell System companies several years ago substituted for the one-year plan a five-year budget plan, designed to obtain as comprehensive a picture as possible of the task ahead for at least that period. This five-year pro-

gram, stepped up annually by adding one year and by correcting for previously unforeseen situations, provides a continuous and dynamic forecast of the problems before the Bell System companies.

General Plan of Procedure

The general plan of procedure in the preparation of these budgets is as follows:

1. The American Telephone and Telegraph Company prepares and forwards to the executives of the associated companies the forms which are used in the preparation of the forecasts, together with certain information as to their preparation to obtain homogeneity in the data. They are also accompanied by estimates for the country as a whole of general business conditions, commodity prices and industrial wages.
2. The executives of the associated companies forward to their local operating officials specifications based on the general information received and, in addition, any necessary statements of policy or other essential factors involved in the preparation of the budget data.
3. The local forces in the field prepare estimates of station and traffic growth, plant additions, revenues and expenses for the respective operating units for which they are responsible. In respect of the anticipated growth of the business, the local officials are governed to a large extent by telephone development surveys and by the related engineering studies which are made for their territories from time to time.
4. The estimates prepared by the local field forces of each company are usually summarized by operating divisions, and these divisional forecasts are reviewed and studied by the respective division operating officials. The divisional forecasts are then combined into a company forecast which is reviewed and studied by the company officials. It is at this point that certain financial data are developed and included in the company forecast.
5. Copies of these company forecasts are forwarded to the American Telephone and Telegraph Company, which consolidates them into a Bell System forecast, thus providing a picture for the System as a whole.

The above indicates that as a preliminary step the executives of the companies must make available a tentative program of general policies in respect of the business and its future development, so that the several departments may have a basis upon which to proceed in bringing together the material for that part of the picture for which they are immediately responsible.

The statistician must give his picture of economic and financial conditions, as these may be anticipated, with their probable effect on development; he must analyze business and labor conditions and the probable trend of interest rates and the money market. The telephone business, it is true, continues to increase with remarkable evenness year by year, in spite of business depressions or other disturbing factors. Nevertheless, economic influences cannot be disregarded, and no estimate of the future of the telephone problem will be fully significant which does not incorporate the result of careful study of economic factors.

The commercial forces must estimate as carefully as possible the increase in population in the territory to be served, the growth of cities and other communities, the extent to which these changes will influence the increase in stations, and the prospective use of telephone facilities by patrons. Possible new forms of service must be studied and their effect on the business ascertained; estimates must be made of the probable revenues which may be expected from each class of service which is or may be offered.

The traffic forces must survey the requirements for handling the service demanded, in the way of both equipment and personnel. Related labor supply and costs must be studied. Various methods of handling traffic must be considered to find the most efficient and economical practices and types of equipment. All of these must be resolved into expected capital expenditures and operating costs for the period.

The engineering and plant forces must consider the traffic and service requirements as forecast for the future, and determine the amount of additional facilities required and the types of plant best adapted to meet efficiently and economically the demands for service as they are foreseen. They must also give consideration to spare facilities, and their fundamental plans must be such as to lay the foundation for meeting still greater service demands in the future in an orderly, step-by-step progression along sound and carefully worked out economic lines. Replacement and rebuilding of plant and equipment must be considered and proper provision made for the maintenance of the property. All of these and many other factors must be resolved into plant, labor and material requirements, capital expenditures and operating expenses.

The accounting forces must provide from their records data as to past performance of every phase of the business. They must also estimate and summarize future requirements as to taxes, fixed charges, dividends, and general and miscellaneous expenditures. Items of revenue must be estimated and tabulated. In fact, every function of the business must outline its program of activities for the period, justify their value to the business and appraise the cost and results thereof. All of these judgments and estimates brought together, co-ordinated and summarized, comprise for the executives an estimate of the task and its probable results immediately ahead of the Bell Telephone System.

Reliability of Forecasts

The forecasts are intended to give a substantially reliable picture for at least one year in advance and a somewhat broader but highly significant picture of objectives and results for the latter years of the five-year period. The methods of estimating the individual items included in the budget figures involve, of course, a great many different assumptions and practices, and

the degree of accuracy obtained naturally varies between different companies and between different items of the budget. That the forecasts for at least one year in advance are, in general, reliable may be seen from the experience with the 1924 budget estimates. For the associated companies as a whole gross additions to plant in 1924 exceeded the estimate by less than 5 per cent, while total telephone revenues and total telephone expenses, respectively, varied less than 1 per cent from the estimated figures. While the results for some of the companies showed greater variations than did the combined figures for the System, the data for individual companies were, nevertheless, sufficiently accurate to warrant the executives in attaching real significance thereto and in using them as dependable aids in administration.

The five-year budget plan aims to provide data which are truly comprehensive and well balanced from all points of view. The facts brought together are intended to show why and how certain things should be done, and what may be expected, particularly in development, capital costs, revenues, expenses and net return, as the result of the action proposed. The scope of the budgets is indicated by the following brief description of the forms used in the preparation thereof:

1. A summary in which the estimates of station growth, plant growth, and earnings and expenses for the next five years are compared with actual performances during the past five years.
2. Certain operating statistics.
3. A detailed description of the plant program for each of the next five years, showing gross additions, retirements, net additions, cost of removing plant retired, salvage, and other information for the various plant accounts.
4. The forecast of revenues and expenses by general classification for the five-year period.
5. The financial plan for the coming year, showing the capital requirements and submitting recommendations as to the means of raising the necessary funds.
6. Estimates of the quantities of certain types of material and equipment required during the coming five years.
7. An analysis of the construction program, with a forecast of purchases of materials for the coming year.

These forms or statements are supplemented by text which discusses the general assumptions on which the budget has been prepared and which provides other data to aid in its proper interpretation.

This fund of information regarding the future of the business enables the administrative and executive officials to consider the soundness and wisdom of their policies and programs for the future. They must review the possibilities in respect of general business conditions, price changes, labor conditions and wages, the demands for service, the requirements for plant additions, improvements and replacements, the requirements for maintenance, operating and general expenses, depreciation, and taxes. They must give due consideration to unforeseen contingencies and make due allowance for estimates of the future based on scanty data. They must eliminate the non-essential in the plans as proposed. The adequacy of the present rate structures must be studied, the revenues expected from new developments must be carefully scrutinized, and a conservative appraisal made of the possibilities of additional sources of revenue. The prospects of obtaining the new capital required must be considered and the probable cost thereof ascertained.

In brief, those who administer the business must obtain a full knowledge of what is involved in their responsibility for furnishing adequate and efficient telephone service for the future, and whether their policies and the programs as proposed by the several functions can be executed, or whether they should be revised, modified or discarded. However, beyond this they must satisfy themselves that the program which is finally adopted will yield a proper and reasonable amount of net earnings on the investment required, otherwise that program, no matter how splendidly planned, must fail, for investors will not long supply the additional capital required unless they are assured of the protection of their investment and an adequate return thereon.

Basis for Continuing Action

In meeting these two major responsibilities, namely, adequate and efficient telephone service to the public, and an adequate return to those who invest their labor and money in the business, the data provided by the budget plans furnish the executives with a continuing basis for action. With the aid of these data, they can lay plans for the future and arrange for the conduct of operations in an orderly and economical manner from every viewpoint. A few of the advantages made possible may be mentioned.

From the viewpoint of future material requirements, when one stops to consider that the equipment and other materials required by the Bell System are for the most part highly fabricated and specially manufactured for its purposes, it becomes evident that construction and service programs must be anticipated and requirements furnished to the suppliers sufficiently in advance, in order that equipment and supplies may be manufactured and delivered under normal schedules. Time should also be available for reasonable foresight as to price changes, to enable a more liberal purchasing of materials during periods when prices are at relatively favorable levels. The supply of raw materials now used may become limited and it may be necessary to find new sources or substitutes if delay and inconvenience are to be avoided. Deliveries of material can be scheduled and made available by the supplier in an orderly manner so that no delay will result when work on a project is started. At the same time, the manufacture and delivery of equipment can proceed in such a way as to limit to the minimum the preliminary non-earning period of capital tied up therein.

From the viewpoint of construction and maintenance work for the future, large and important developments and projects can be studied and possible alternative

plans considered to find the best and most economical way to meet the desired result. Switchboards and installations must be engineered, and construction activities co-ordinated. Replacement and maintenance programs must be prepared. The necessary workmen can be trained in advance so as to be skilled and experienced in their work. The general demand for and supply of available labor can be analyzed and a continuous program of work arranged so that skilled labor may be continuously employed. In brief, plans can be made to conduct the necessary operations year after year on an even keel without undesirable changes in working forces and labor turnover.

From the viewpoint of operation, there is afforded an opportunity to study increased service demands, and if these require that methods of handling traffic be revised, or that new and better facilities be provided or new methods designed to meet the requirements, this can be done. The necessary operators may be provided and trained and the source of supply analyzed to ascertain whether the needs of the System can be met or whether other methods of handling the traffic must be employed. Anticipated operating expenses of every type may be scrutinized and plans laid to ensure the latest and most economical methods.

From the viewpoint of revenues which are required to make possible the success of any program adopted, the budget plans provide an opportunity to plan carefully in advance for rate schedules which will be adequate and consistent with the type of service rendered, yet reasonable in cost and adapted to develop the use of the service. New sources of revenue may perhaps be arranged by developing more effective and more intensive uses of the service. Rate situations may be systematically studied and equitably adjusted so that rate litigation may be avoided except only as a last resort.

From the viewpoint of supervision, the data so made available affords an excellent means of checking actual performance. If the estimates take full account of all of the conditions under which the proposed work must be done, and its actual performance presents higher costs or other unfavorable conditions, an opportunity is afforded to check whether the work was done efficiently and economically, or whether it was properly organized and supervised; in brief, whether the desired result is being obtained at the lowest possible cost.

Finally, one of the major functions performed by the budget plans is to lay a sound foundation for financing. After the entire program for the immediate future has been summarized and reviewed, the problem presented is that of financing the projected undertakings. All proposed activities must be resolved to capital costs and net earnings. If net earnings are not adequate to yield a proper return, one of two courses of action must obviously be taken—either the program must be modified or more revenues must be made available.

The American Telephone and Telegraph Company and its associated companies comprising the Bell System have the task of furnishing an efficient national telephone service. In performing this task the development of a well organized and intelligent force of men and women has been necessary and an investment aggregating almost $2,500,000,000 is now involved. The future promises that the business will assume even greater proportions, that more complex service and operating problems will be encountered, and that additional capital must be obtained.

To meet this responsibility for the future, a careful study of past performance is required, and careful and logical planning for the future must be in evidence, to assure that development and growth will proceed in an orderly, economical and stable manner, and that telephone service rendered by the Bell System will be adequate and efficient.

Procter and Gamble Plant Adds to Storehouse

THE H. K. Ferguson Company have just been awarded a contract for the erection of additional storage space for the Procter and Gamble plant at Staten Island, New York, through raising the upper portion of the present warehouse and constructing another floor under it. The cost will be about $150,000.

The building is of brick and steel construction, 100 by 500 ft. What will eventually be the floor for the second story is to be erected directly under the truss spans of the present structure, which will be kept in use during the remodeling. After the new floor is laid, the brick side walls from the level of the truss spans, the truss spans, and the top of the present building will be raised in three sections to permit installing the necessary additional brick and steel work for the second floor.

While the present 50-ft. span will be continued in the second floor to support the mill-type roof, which is to be retained, the new design calls for supporting posts in the first floor at intervals of 16 by 20 ft. Both floors will be of plank construction. The present windows are to be carried up to the second floor, and new windows will be cut through the walls to serve the first story. The present building was designed and erected by the H. K. Ferguson Company in 1918.

WAREHOUSE TO WHICH SECOND STORY WILL BE ADDED

Hyatt Methods of Material Handling

Economical System for Quantity Production of Small Parts

By H. J. FORSYTHE

President and General Manager, Hyatt Bearings Division, General Motors Corporation

IT is the aim of present-day production to route work in process through the most efficient sequence of operations with the minimum manufacturing delays, and also to decrease human fatigue by improving handling conditions, with a resulting increase in the efficiency of labor.

The divergence in products and operations in each industry necessitates a detailed study into the conditions of each plant layout. The following factors must be considered:

1. Building arrangement and type of structure.
2. The number and location of separate manufacturing departments.
3. Multiplicity of operations within each department.
4. Nature of the product.
5. Number of and variety of sizes of product.
6. Details of the factory cost system.

Admittedly the simplest type of material handling layout is that covering a single building, one story high. As the number of floors of a building increases, the complexity of the problem increases, particularly if the aim is to handle material through the entire plant by mechanical conveyor methods.

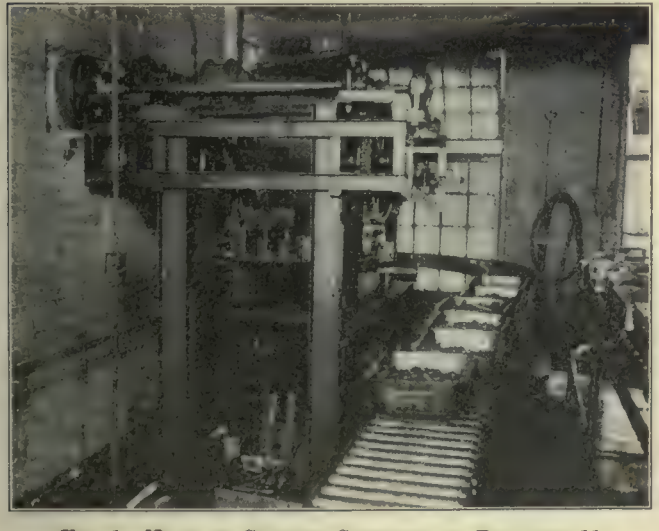


FIG. 1 HEAD OF GRAVITY CONVEYOR IN BUILDING 11

A number of separate departments may be located on each floor of the factory building group, in which event the individual floor layouts present peculiarities and minor difficulties which add to the necessity of carefully studying the factors previously mentioned.

A great number of individual operations on a complex product, involving a large number of various sizes and types, are very important items to be taken into consideration in close alliance with the first two factors. It is obviously much simpler to handle parts of a product made in one type and three sizes than it is to handle a product made in three types and in 300 sizes. This is particularly true with a shop on a piece-work system where all incoming and outgoing material must be maintained in separate containers, separately weighed and checked, in order that individual output may be clearly and accurately determined without confusion and without penalizing the workmen's wages based upon these quantities.

To make weighing as simple as possible, it is good practice to introduce weighing mechanisms into the conveyor layout along the line of travel. To avoid prohibitive overhead, it is important to keep the number of these weighing stations at a minimum.

There are a number of ramifications of the above general points which cannot be gone into in detail at this writing but which must be considered in each individual plant. A modern manufacturing structure centers around a plant machine arrangement designed to take full advantage of the possibilities of automatic conveying systems in eliminating trucking, handling and labor fatigue. It is the aim of the modern manufacturer to keep work in process moving on mechanical conveyors, thus eliminating the necessity for accumulations of work in any department or operation, which in turn increases the speed of work flowing through the plant, decreases lost production time, acts as a spur to the individual operator, and increases general efficiency.

The conveyor idea can be abused by a tendency to overcrowd manufacturing operations with automatic carriers. Here, however, we must consider the nature and range in sizes of the product. We must not lose sight of the fact that what is ultimately desired is the transportation of material at the lowest cost. We must not supplant one system, whether it is hand trucking, electric trucking, or automatic conveyor, with another system unless the labor saving effected by the

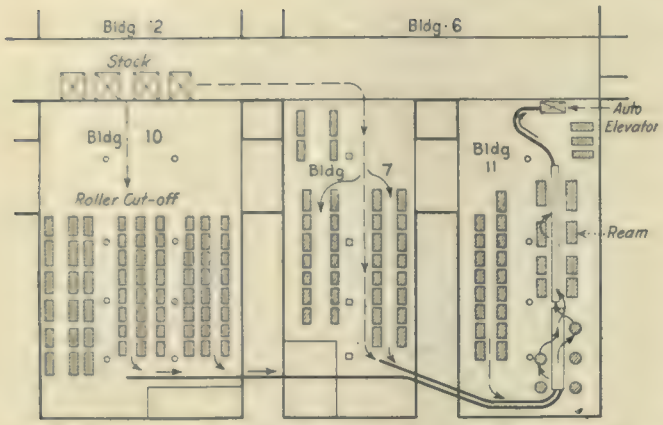


FIG. 2 ROLLER CUT-OFF AND REAMING, SHOWING MACHINES AND CONVEYORS

change warrants a change in equipment. It is not always feasible to use other than hand trucks. In the Hyatt plant we have found it practical in one case to use a truck of approximately the same height as the machine base. This truck acts as a carrier or tote box for the work and is merely drawn from one operation to another on the same floor in the same department without direct trucking labor, thus allowing continuous segregation of parts handled, accurate cost control and avoidance of mixing sizes.

It might be well at this time to mention another point which has to do with the construction of the equipment used for handling the material through a shop. It should be rugged and securely framed, and as simple as possible. Designs involving automatic switches and other automatic features should be studied carefully before installation, as these may lead to excessive maintenance cost and interruption of service if not carefully devised and installed. Gearing and bearings should be of such design and type as to require minimum maintenance and minimum shutdown loss.

In our plant it was necessary to take care of two main arteries, or lines of travel, of parts. Our product consists essentially of four parts—rings, bars, rollers and races. The first two items are produced in from one to three main operations in one location. This is made possible by the nature of the pieces and the adaptability of the equipment used in their production. The operations on rollers and races, however, are many and complex, and the length of travel through different floors of different buildings lends itself readily to automatic material handling systems.

The result of the winding operation on rollers is a coil approximately 10 ft. in length which must be carried by hand-propelled truck and standard freight elevator to the automatic cut-off room. The product leaves the cut-off in tote boxes by gravity carrier and is first conveyed to the burring operation, then to heat-treating, grinding, inspection and stores. Automatic elevators are used in carrying the work from one floor to another, while gravity conveyors supplemented with power boosters are used on any one particular floor level. (See Figs. 1 and 2.)

It was found impractical to attempt to carry the work to the individual machines in each case because of the great variety in sizes. The carrier must be such as to allow flexibility in machine set-up. A diagrammatic sketch of the heat-treating room is shown in Fig. 3. The main string of the conveyor is double-decked to conserve floor space.

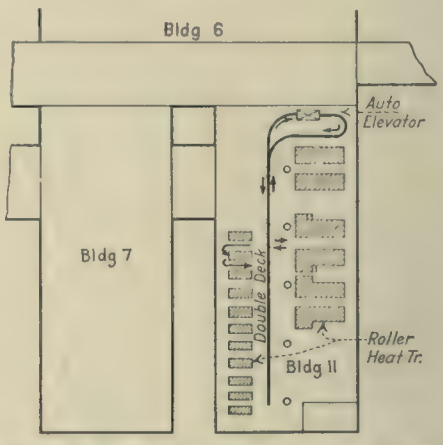


FIG. 3 FLOOR PLAN OF ROLLER HEAT-TREATING ROOM, SHOWING MACHINES AND CONVEYORS

A general layout of the drawing, grinding and inspection departments is shown in Fig. 4. The plan of ending the conveyor at the inlet point of a department and effecting further distribution by hand truck is shown clearly in the roller grinding department. A dispatching system was considered for this point but was not considered economical enough to replace the present method of work distribution to the machines.

This applies, as will be noted, all through the layout. With the large number of sizes and varieties we

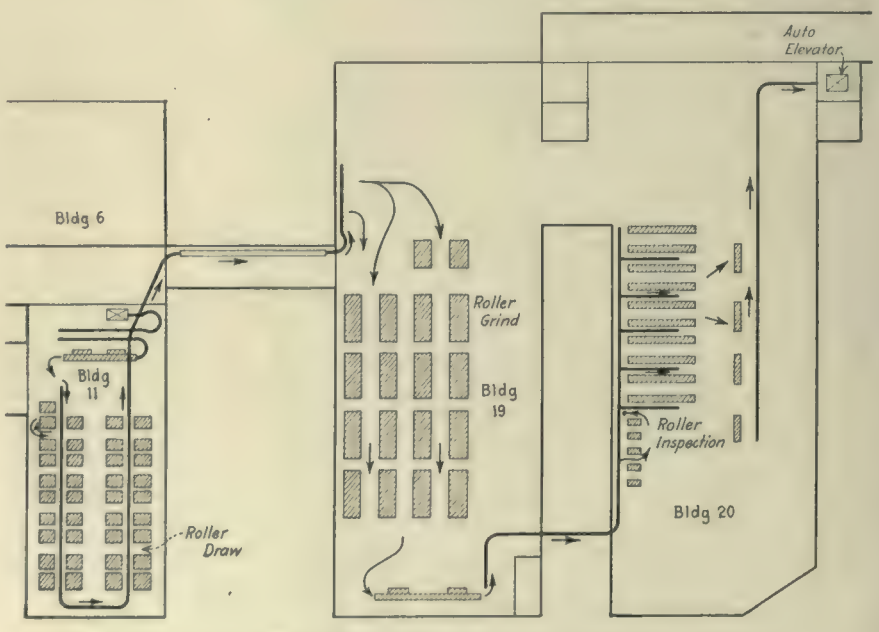


FIG. 4 DRAWING, GRINDING AND INSPECTION ROUTE ON SAME FLOOR OF DIFFERENT BUILDINGS

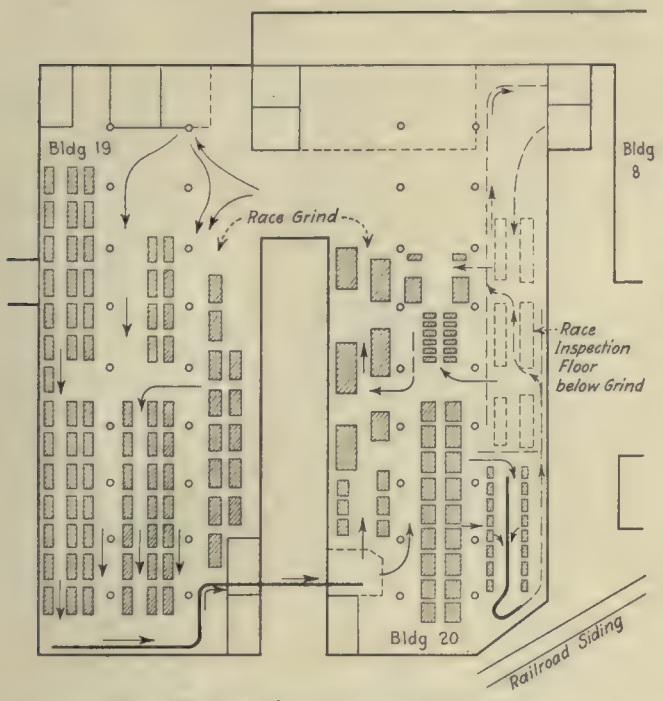


FIG. 5 RACE GRINDING AND INSPECTION
Dotted lines represent inspection benches and routes on floor below grinding department.

produce, it is not practical to route work to the various machines, as the flow would either have to be uniform, or a storage space ahead of each machine would have to be allowed. It will be noted that, wherever possible, the conveyor is adjacent to the inlet of the machine as in the reaming room, Fig. 2, and in the heat-treating room, Fig. 3. The drawing furnaces are of the tilting type, and working space must be available in front of the furnaces. For this reason the conveyor is placed between two rows of furnaces with aisle space to allow free access from the front of the furnace to the conveyor.

The preliminary operations on solid races are rather scattered and improvements in prospect for these departments prevent any immediate change in handling methods. As the departments are widely separated up to the grinding operation, a standard electric lift truck is used with platform skid and tote pans for holding the work. This is not so costly a method as might appear at first glance, and under the present conditions it has a number of factors in its favor aside from the monetary advantage.

When the race grinding operation is reached (see Fig. 5), it is found possible so to locate and arrange operations in this department in machine groups as to use hand-truck distribution successfully through the department (see Fig. 6), with conveyors tying in with distribution centers and also removing the work from this department to the inspection department on the floor below.

In the inspection department the "feed in" conveyor is also arranged to be available to the inspection benches. After going through the inspection operation, the product passes by gravity to an automatic elevator which carries it to the second floor of this building for stores or assembly for shipping.

Handling of material by hand and electric trucks was our method in the past. Our gravity systems were installed to replace such trucking operations where more economical handling could be secured and where an appreciable return on the expenditure was made possible by the change. Although the entire system is not yet in operation, our results so far measurable and in sight reflect such decreased hauling costs as to justify the cost of the new equipment, including the depreciation and incidental operating costs common to the types of equipment replaced and installed.

Intangible items, such as improved planning and more rapid progress of work through the manufacturing departments, decreased storage or "reserve" in each department, are not included in any operating cost comparison, although of primary importance when an increase in the general plant efficiency is the sole object of speeding up any of its departmental divisions. The urge given any one department by a preceding department is possible through direct transportation of material and is the spur to rapid delivery of material all along the line of production. It brings the familiar assembly line of the automobile plant into play in the whole plant of the parts manufacturer.

It is felt that the main items of saving possible are taken care of in the two major systems above outlined. There are, however, small direct routes of travel of parts in process which are being developed and improved wherever the return in labor saving and

FIG. 6 HAND TRUCK DISTRIBUTION IN DEPARTMENT 3

fatigue or other production factors warrant the investment. Some of these problems hinge upon the development of manufacturing equipment which will allow a rearrangement of certain operations. As before mentioned, a logical arrangement of machines and departments is necessary before anything can be accomplished in the way of improved material handling.

One particular case which was corrected involved the handling of box shooks and built-up shipping box stapling machines which were in two separate locations, with material stored elsewhere in two places. Fig. 7 shows the saws on the ground floor of a small, three-story building, with the nailing machines on the second

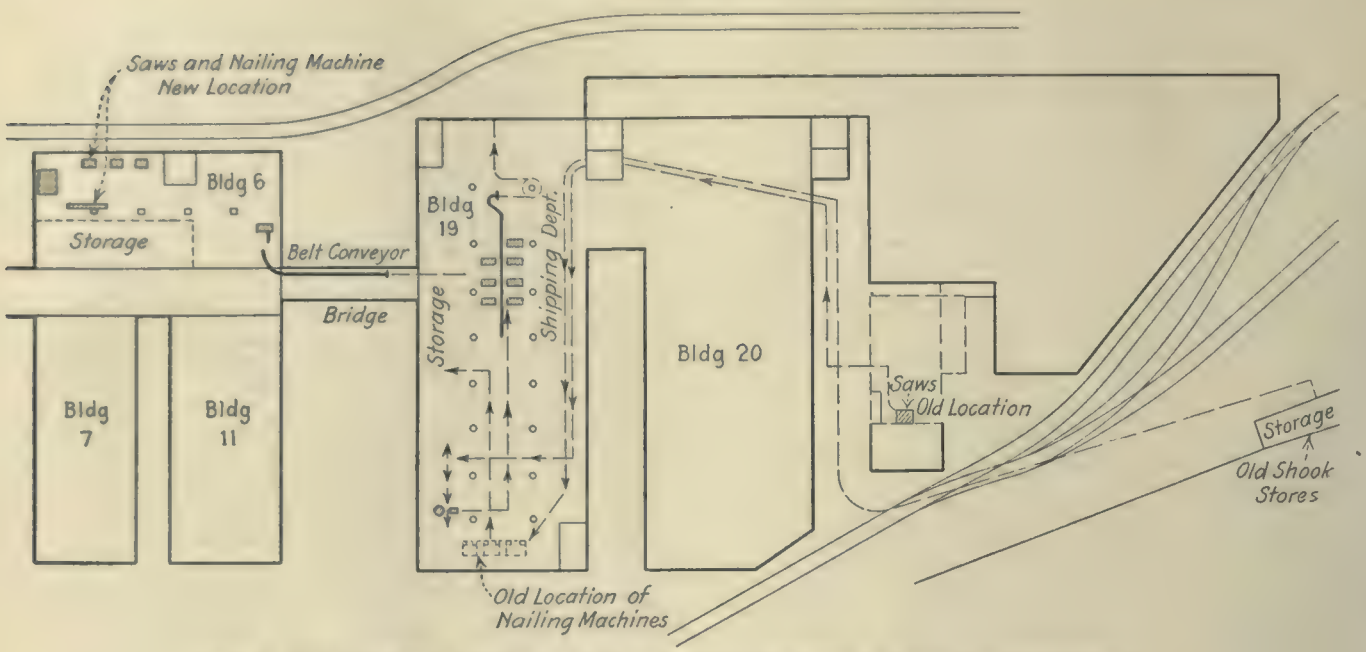


FIG. 7 OLD AND NEW ARRANGEMENT OF BOX MAKING SECTION OF SHIPPING DEPARTMENT
Dotted lines show former travel of material.

floor of a building distant horizontally 200 ft. This necessitated transportation to the extreme north end of the building and back to the south end again, or a travel of 560 ft. horizontally and one floor height to the same location to be shaped into cases. The rearrangement made possible the storing of all material on the first and second floors of a different building with the sawing, nailing and stapling equipment all on the second floor of the same building. A belt conveyor runs from the stapling machine direct to the packing section of the shipping department. The material is unloaded from a railroad siding adjacent to the building. All trucking is eliminated as the boxes are supplied directly to the point of consumption; therefore, an auxiliary storeroom of made-up cases is not required in the shipping department. All of this results in economy of operation through decreased inventory, and a speeding up of production in the departments affected. This installation of conveyors repaid its cost in less than a year.

An improvement was made in the method of handling reclaimed carburizing material which saved yearly more than the cost of the installation. Sand is used as an insulator for localizing carburization and it was necessary to screen the old material and then make a proportionate mixture with new material. The "new and old" mix was made by hand, keeping a couple of men busy most of the time. By putting in a simple bucket elevator discharging optionally into two overhead bins, and draining the bins into our mechanical continuous mixer, it was possible to eliminate the hand mixing completely, the storekeeper of carburizing materials doing all of the work.

These isolated cases of improvement are often neglected in aiming at the big problem, but they are sometimes proportionately more important and more easily and definitely solved, often with remarkable results.

The collection of rubbish through the plant, such as floor sweepings, old sawdust used in wet or oily departments on the floors, and waste paper was improved in this manner. Formerly two men and an electric dump truck made two trips daily to collect such material. To solve this problem, three long vertical chutes were installed in central locations, running down the outside of the buildings. An opening into these chutes on each floor of the buildings allows the dumping of rubbish into the chutes, which discharge into large trailers on the ground level. Periodically during the week a tractor removes these trailers, hauling them to an incinerator at one corner of the plant, where the combustible material is burned.

These latter cases are mentioned as only incidental to the main topic of production material handling. When the regular production installation in the plant is completed, according to present plans, the total earnings on the investment will be 38 per cent.

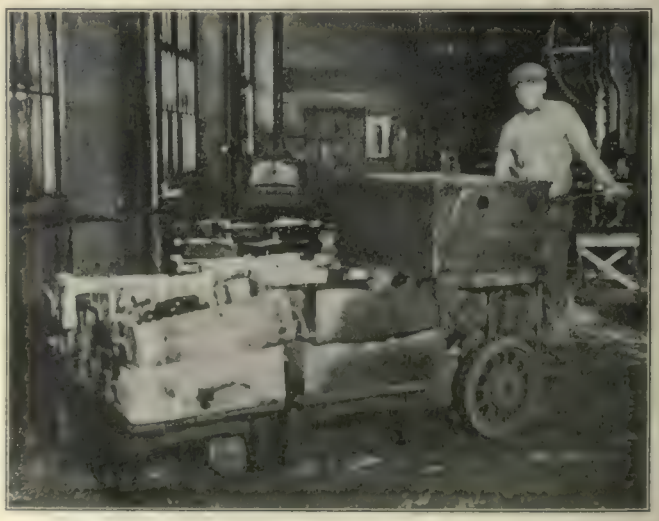


FIG. 8 ELECTRIC TRUCK LEAVING DEPARTMENT 3

Organizing the Tool Crib Personnel

Worthington Methods of Controlling Work and Training Workers

By ANKER L. CHRISTENSEN

Engineer, Tool and Material Storage Department, Worthington Pump and Machinery Corporation

STANDING orders are very effective in operating a tool crib,[1] because the work involved in this department can be standardized and undergoes few and infrequent changes. But changes in the working force are apt to occur, due to promotions to other departments, men leaving, absences, etc., and hence a definite procedure for the various tasks, written in the manner of specifications, serves to stabilize tool room control at all times.

A sample of the standing orders issued at the Worthington Works follows:

TYPE OF TOOLS UNDER SUPERVISION OF TOOL CRIB FOREMAN

Tools which should be under the supervision of the tool crib may be divided into four classes:

1. *Tools used on more than one machine or by more than one workman.* Tools of this class should be kept in the tool crib and should not be taken from it unless a standard tool check is received from the worker who is to use the tool, except when sent out for repairs. A complete list of these tools should be kept in the tool crib on perpetual inventory sheets.
2. *Tools which are part of the equipment of one machine,* and are to be used on that machine only, such as steady rests, lathe tool packing pieces, wrenches for tool testors, etc. Tools of this class should be inventoried as part of the equipment of the machine to which they belong. A complete list of such tools should, however, be kept in the tool crib. The tools should be filed in regular cabinets, adjacent to the machines to which they belong. Should the machine be shut down for a period of more than one day, the cabinet should be locked and the keys given to the tool crib foreman.
3. *Tools which are used continually by one workman only.* This class consists of such tools as electrician's, millwright's, pipe fitter's, erector's and tester's kits. Tools such as oil cans, brushes, screw-drivers, etc., are also included in this class. A record of this class of tools should be kept on the regular tool inventory. They should be charged to the workmen on special forms. The forms are made out in duplicate, the original being filed in the tool crib, while the duplicate is given to the workman for his own reference so that he may know at all times what tools he is charged with.
4. *Tools which are everybody's and nobody's.* There are many tools in this class such as wheel-barrows, shop trucks, step-ladders, etc. A record should be kept on the regular inventory of all items of this class of tools. A definite place should be assigned where each tool is to be kept when not in actual use.

In order to aid busy executives and reduce to a minimum the routine details to be remembered, Frank B. Gilbreth worked out a very effective adaptation of Frederick W. Taylor's follow-up and reminder system. This reminder or tickler file consists of a number of pockets, or drawers, marked 1 to 31, to cover the days of the current month. Then there are drawers for each of the twelve months of the year, and there may be space allowed for the reminder slips that are not to come up until a few years hence.

The operation of the system is very simple. When the executive desires something brought to someone's, or his own, attention at a later date, he makes the necessary memo on a reminder slip, filling in the name and date on which said person is to be notified. These slips are collected by office messenger boys and delivered to the reminder file clerk, who places them in the file drawers marked for the dates on which they are to come out.

Each day of the month, the reminder clerk removes the reminder slips coming up on that day from their file pocket and sends them to the person who is to be notified. At the end of the month, the slips that have accumulated in the file for the succeeding month are removed, sorted and placed in the current daily file, and at the end of the year the slips that have accumulated for the following year are placed in the proper monthly files.

To facilitate the following up of standing orders, the registered reminder slip is used. One of these cards is made out for each standing order. The number and subject of the order is written on the face of the card while the back of the card is ruled up for use as a time table to record the dates that the card is to be sent out to the person responsible for carrying out the standing order.

Changes in Standing Orders

When a standing order has become obsolete through changing conditions, it should be promptly revoked. This changing or recalling of a standing order should be as carefully done as the issuing of the order in the first place. The same person that makes the order effective should make the change effective.

Five points should always be considered when any

[1] See MANAGEMENT IN MANUFACTURING, May 1925, pp. 467-470; June 1925, pp. 537-540; July 1925, pp. 15-18; August 1925, pp. 95-97, for previous articles on Worthington tool storage methods.

changes are to be made in the standing orders, as follows:

1. What order is to be changed.
2. What changes are to be made.
3. Reasons for making such changes.
4. Who is to be notified of the changes.
5. Who is to authorize the change.

A form used to take care of change orders contains spaces for the following data:

1. Basket numbers, for routing the change order to the correct persons
2. Symbol of tool
3. Drawing number
4. Pattern number
5. Order number
6. Standing order number
7. Date
8. Detail statement of changes to be made
9. Reasons for making changes
10. Signatures (initials) and dates of signing of persons concerned:

(a) Suggested by
(b) Approved by
(c) Effective by
(d) Works manager
(e) General superintendent
(f) Production manager
(g) Office manager
(h) Treasurer
(i) Equipment engineer
(j) Purchasing department
(k) Shop superintendent
(l) Foundry superintendent
(m) Order record
(n) Record of charges
(o) Cost department
(p) Outside erection
(q) Routing and rating
(r) Stock ledger
(s) Engineering department
(t) Receiving department
(u) Purchase storekeeper
(v) Tool crib
(w) Tool room
(x) Tool inspector

The best way to record tool room information is by the use of carefully laid out forms. In designing a form for the tool room, or any purpose, the following points should be considered:

1. Arrangement of the information.
2. Conservation of space and size of forms.
3. Standard instructions for filling out and using forms.

Arrangement of Information. In laying out a form, consideration should be given to the points of information of most importance and those most used. Generally speaking, form numbers or reference information should be placed at the top, where it can be seen easily when sorting and filing the forms.

Conservation of Space. A casual inspection of the great majority of forms used in most factories discloses the fact that about 20 per cent of the available writing space is taken up by fancy headings, printed in large, bold type. This may be good advertising (on forms used outside the factory) but for those used exclusively in the shop, it is a waste of space that could be used to better advantage.

Standard Instructions for Filling Out Forms. To insure that the forms are properly filled out, standing orders should be made for each, stating what information is to be entered in each space. The spaces in the forms should be numbered to make it easy to follow the instructions; i.e., with the spaces properly numbered, it is only necessary to state the space and give information or data to be written in the space.

Tool Crib Personnel

The men necessary to operate a tool system for a large factory should be chosen with special regard to personal characteristics, familiarity with tools, and their appreciation of the responsibilities of the work. As a rule they should not be tool makers, but rather men who have a fair grasp of different machine processes. The following is a logical classification for personnel in a tool crib:

1. Foreman
2. Tool inspector
3. Clerk
4. Crib attendants
5. Laborers
6. Apprentices

Foreman. The tool crib foreman has perhaps one of the hardest jobs in the whole plant. His duties are varied, and include the responsibility for issuing tools, entering purchase requisitions for replacement of worn out stock, and seeing that all tools are in perfect condition. He has general supervision over all the work of the tool crib, and is responsible for keeping the proper tools laid out beforehand for each job. In general, the requirements for this position may be analyzed about as follows:

A. GENERAL QUALIFICATIONS:

1. *Educational.* A foreman should have at least a grammar school education, and a wide-awake mind. He should read mechanical trade papers and magazines—preferably those dealing with tools and their control.
2. *Experience.* It is desirable that a foreman should have had some varied experience in line with this work, or that he shall have worked at the trade, or served an apprenticeship in a machine shop—preferably in the factory's tool room.
3. *Character.* A man for this position should be honest, patient, and loyal, both to his firm and to his men. He should be a close observer, an independent thinker, and have ability to reason out the fundamental facts and causes in any given problem and make quick, clear-cut decisions. He should be willing to accept responsibility, and to obey orders himself as well as exact discipline among his men.
4. *Leadership Qualities.* A foreman should have tact and a persuasive personality, i.e., ability to get his men to do their work with a fine spirit of cooperation—without seeming offensively arbitrary in giving orders. He should be able to get along with all kinds of people, see all sides of a question, meet his men in a kindly, approachable manner, and teach them how to do their work in the best possible way.
5. *Physique and Health.* (No arbitrary ruling, but a desirable standard to strive for.) Average age—35 years; height and weight—proferably above the average. Should be in a normal, healthy physical condition, active, energetic, and possessed of endurance.

B. DESCRIPTION OF WORK FOR WHICH FOREMAN IS RESPONSIBLE:

1. Issuing of all tools.
2. Storing and caring for all tools in the crib.
3. Keeping all tools in good working condition.
4. Reporting damages to tools or other property, and taking action to prevent, if possible, further damage of like nature.
5. Supplying sufficient tools to the men when needed.
6. Seeing that proper records are kept of tools, as required by standing orders.
7. Maintaining sufficient personnel, and training men for the work.
8. Carrying out policies of management.
9. Carrying out all regulations and standing orders which have been adopted by the management for the control of the tool crib.

Tool Inspector. Mastery of all kinds of tools is a prize requisite for this position. While the tool inspector's contact with the men is limited to his periodical inspections of the tools at the machines or in the permanent possession of the men, and to checking up causes for broken or damaged tools, still it requires considerable tact and judgment to handle this part of the work. A detailed analysis follows:

A. GENERAL QUALIFICATIONS:

1. *Education.* Grammar school is essential.
2. *Experience.* An inspector should be an experienced tool maker, a master of gages and methods of measuring, and it is desirable that he shall have had several years' experience in his line of work.
3. *Character.* Must be alert, a keen observer, and able to analyze trouble and find causes for unusual conditions. Should be honest, accurate, and loyal to the firm.
4. *Leadership.* Must be able to get along with the men, and to teach them what trouble to look for when inspecting tools. Should be self-controlled, patient and an energetic worker.
5. *Physique and Health.* Desirable age—35 to 40 years. Should be healthy, active, and about average in height and weight.

B. DESCRIPTION OF WORK FOR WHICH INSPECTOR IS RESPONSIBLE:

1. Seeing that all tools returned from the tool room check to drawings; also that they are properly marked, made and hardened.
2. That tools purchased from outside vendors are made strictly to specifications, and that those not up to standard are promptly rejected.
3. That the tool crib attendants are properly instructed in the duties of inspecting tools that are being returned from the shop.
4. That all damaged tools are tagged as to the amount and nature of repairs needed to bring them back to good working condition.
5. That all tools locked up permanently with the machines are inspected.
6. That all special tool kits in possession of the men are properly inspected.
7. That the tools put in the outside erection tool boxes are in good working condition.

Clerk. Whether or not a clerk is necessary in a tool crib depends upon the size of the crib, and the amount of clerical work to be done. In small factories the clerical work may be handled by the foreman, but in large factories the foreman is generally too busy to look after the vast amount of record keeping that is necessary. An analysis of a clerk's job follows:

A. GENERAL QUALIFICATIONS:

1. *Education.* A clerk should have at least a grammar school education. Should be able to read and understand orders, and handle the clerical work with accuracy and dispatch.
2. *Experience.* Should have a general knowledge of tools and their uses. He should be a good penman, and have a general idea of proper record keeping. It is desirable that he have some experience in the drawing room so that he can read blue-prints and make sketches.
3. *Character.* Should be alert, accurate, thorough and loyal. He should have a sense of the responsibility of his work—that of keeping records, etc., up to date and correct at all times.
4. *Leadership.* In some cases the clerk is in line for the foreman's position; therefore, he should possess all the potential qualities of leadership required of a foreman.

B. DESCRIPTION OF WORK FOR WHICH CLERK IS RESPONSIBLE:

1. That all records are properly kept in accordance with standing orders.
2. That requisitions are properly made out for the purchase of new tools and supplies.
3. That orders are properly followed up and receipts checked against open orders.
4. That proper orders are made out for repair, or manufacture, of tools when work is done in the factory's tool room.
5. That these orders are properly followed up to see that they are completed on time.
6. That all catalogs are properly indexed and filed.

Tool Crib Attendants. The men who actually give out and receive tools in the crib and make up the standard tool sets for the various machining operations are known as tool crib attendants. These men are to the tool crib what the machine operators are to the shop. An analysis of their qualifications and work follows:

A. GENERAL QUALIFICATIONS:

1. *Education.* The crib attendant should be able to read and write. Grammar school education is necessary.
2. *Experience.* Should have a general knowledge of tools and their uses, and experience in handling tools and stores; and should be able to interpret the poorly stated requests, and give out proper tools. These men should know in general what tools each class of machine operator needs.
3. *Character.* The attendants should be responsible, careful, and accurate. A wrong gage given out may spoil hundreds of dollars worth of work.
4. *Leadership.* In many cases the vacancies of foremen are filled by attendants of the crib or sub-crib. Therefore, they should have the foreman's qualities.

B. DESCRIPTION OF WORK FOR WHICH ATTENDANTS ARE RESPONSIBLE:

1. That workmen coming to the window for tools are served quickly and correctly.
2. That tools are not given out to men who have no use for them.
3. That tools are given out only in exchange for workmen's tool checks.
4. That tools returned to the crib are not put in the bins when dull or damaged.
5. That proper report is made of damages to tools before they are accepted into the tool crib.
6. That only tools in good condition are allowed in the storage bins and racks.
7. That tools are in their proper places.
8. That tools and bins are correctly marked.
9. That standard tool list requests are properly filled out.

Laborers. The men who deliver tools to the mechanics and bring them back to the crib after completion of the work are classed as laborers. The tool crib laborers should be of a higher grade than the average yard laborer or the sweepers about the factory. If these men have the necessary education and grasp of the work, they should be in line for promotion to crib attendants. A brief analysis of their work and qualifications follows:

A. GENERAL QUALIFICATIONS:

1. *Education.* Men should be able to read and write and to understand the work.
2. *Experience.* Experience with tools is not absolutely necessary but very desirable.
3. *Character and Health.* Good average. Should be alert, active, and well disciplined in carrying out orders.

B. DESCRIPTION OF WORK:

1. Delivering tools to workmen and seeing that the men sign for same properly.
2. Taking tools to tool room to be repaired.
3. Keeping tool cribs clean.

Apprentices. These men should be required to spend some time in the tool crib during the term of their apprenticeship in the machine shop department. Any factory that follows the practice of taking on apprentice workmen should aim to train them to the point of greatest usefulness—both to the company and to themselves. They should not only be familiar with tools but also know where tools can be found and have a general idea of what equipment the tool crib carries. Since tools are the vital factors of any workman's productive capacity, every apprentice should be taught their value and how to care for those in his possession.

There is no place in the whole factory where a boy can get as good a general idea of the variety and use of tools that are carried as he can in the tool crib. Here the apprentice has the opportunity to learn the tool issuing system, the location of tools, the machines they are on, and, in general, a great deal about mechanical work.

There should be a definite plan of promotion within the tool crib. This, of course, should not conflict with the general policy of the company. But every employee should feel assured that he will be given just consideration for filling higher grade vacancies as they occur, provided he has the ability and experience to qualify for the position. A laborer with several years' experience in the shop should be given preference over an outside man for the position as tool crib attendant if he has the necessary qualifications. Likewise, a crib attendant should be considered for clerical positions when vacancies occur, and so on up the line. There should at all times be an assistant, or understudy, to the foreman, who is capable of taking charge in case of the foreman's absence.

In the average large factory, the size of the tool crib makes it necessary to assign attendants to certain sections. The full time of two men is required to handle a certain class of tools in the Worthington factory. A plan to rotate men in the various sections of the tool crib is advantageous to all interests. If the men are required to spend one week out of every six in other sections of the crib than those to which they are permanently assigned, the department heads will be enabled to shift them about with a greater degree of efficiency and with very little confusion in case such a course becomes imperative. This practice also provides a greater number of workers for night and Sunday duty, and insures smooth operation when the shop has to work overtime.

General Electric Home Owning Plan

THE General Electric Company, recognizing the desire of many of its employees to acquire their own homes, has put into practice a plan by which it gives assistance to employees in any of its plants. A housing committee has been appointed at each of the plants to co-operate with the employees to this end.

Although the company assists employees in planning homes, suggesting architects and contractors, perhaps the greatest help has been in enabling the workers to secure second mortgages, usually the most difficult part of financing in buying a home. Stated payments of interest and partial payments on the principal are deducted weekly or monthly from the employees' pay by the company so that the second mortgage is completely paid up in not more than eight years.

The company expects the employee to invest a reasonable equity of the value of the property and to provide for the first mortgage through a bank or building loan association. The Company will then, on approval of the works housing committee, assist him to finance a second mortgage through a local bank.

The plan has been in operation at Schenectady for more than two years and, up to May 1, 163 employees of this plant had received assistance from the company. This assistance consisted of arrangements with the Schenectady banks to advance $290,829 on mortgage loans.

The total cost of the property on which such loans have been made is $1,267,356. The employees themselves paid $315,997 toward the homes at the time they purchased the property.

Successful Methods for Increasing Sales and Balancing Production

Management in Southern Furniture Plants

By CHARLES F. SCRIBNER

Mechanical Engineer

THE distribution problems presented in manufacturing furniture[1] are distinctly different from those encountered where products are sold direct to the consumer and where the element of style and design is not one of the most important, if not the most important, factor. The practical solution of these problems is made more complicated by the semi-annual furniture shows which are held during the mid-summer and mid-winter at the chief producing centers.[2]

At these shows designs are exhibited to buyers of the retail furniture establishments throughout the country, and upon the appeal of the designs shown and their "selling value" orders are placed for immediate and future delivery. Through this procedure the manufacturer does not know until he has exhibited his new patterns, just how well they are going to sell and to what extent he can turn his factory loose to go ahead with the production of the line or lines in question.

There is an element of safety for the manufacturer in the fact that he generally produces two, three or four different patterns, and that for each show one of these patterns is replaced with a new design, while the remaining patterns are continued in his line.

This works out so that a pattern which has been found to be acceptable in any line where four different patterns are carried, will have a life of two years from its initial exhibition until it is dropped and replaced by a new pattern. Where three patterns are carried, this life will be 18 months; while when only two patterns comprise the line, the life of a particular pattern is usually one year. Experience has proved that any attempt to "force" sales by failing to bring out a new design at least once a year is almost sure to result in loss of sales volume for the concern making the attempt.

Tying Together Sales and Production

To bring out a new line of dining room or bedroom furniture the practice of the progressive plant is to have a high-class designer make up scale drawings of the various units which comprise the suite, these drawings showing all details and representing the designer's interpretation of the style which the buying public demands, modified to suit the manufacturing ability of the plant in question and to come within the price range at which that plant aims.

It is only in the very largest plants that the full-time services of the designer are employed. In practically all southern plants the designer is paid a fixed sum per unit designed, or a flat monthly fee, with the understanding that a certain number of designs are to be furnished each year. As the successful designer must absorb the "atmosphere" of the various markets, it will be seen that by this part-time employment the manufacturer secures a higher degree of ability at a lower cost than if the designer was permanently employed.

Samples Made Up for Sales Use

When the drawings are submitted and accepted, the factory proceeds to make up from three to six pieces of each unit, to be used as samples. While these units are "in the white," or before they are finished, photographs are made for the use of the sales department, after which the units are finished and shipped to the markets for display.

In the production of these samples it has been found that the sales manager should work in the closest co-operation with the factory. As it is the sales department's responsibility to secure volume distribution of the patterns when they are placed upon exhibition, the suggestions and recommendations of the sales manager for changes in details and modification of designs must be given careful consideration before the samples are completed and the photographs made.

In every case I have found it highly profitable to have the sales manager pass upon the samples and accept them before they are shipped to the several exhibition points. This may seem a simple matter, but neglect of this feature has been the cause of troubles in the samples delivered and has caused a feeling of antagonism between the sales and manufacturing divisions of the business that has been reflected in smaller sales and decreased profits.

The responsibility of the sales department is focused and a definite objective furnished for the factory to work against, by means of the master program which is shown in Tables 1 and 2. As preplanning can only be carried forward between one market and the next, such master program is limited to cover only the six months' period. With such a program prepared by the

[1] Preceding article on this subject appeared in MANAGEMENT IN MANUFACTURING, August 1925, pp. 83-86.

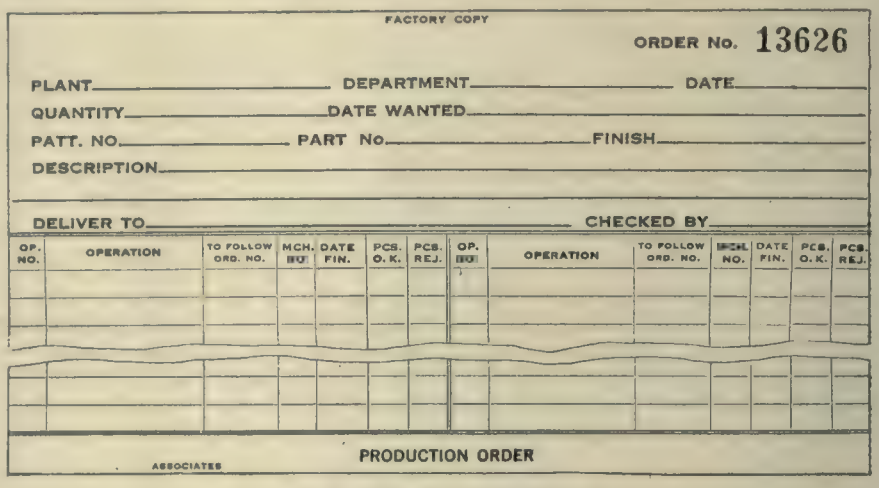
[2] Among these are Grand Rapids, Mich., Chicago, Ill., High Point, N. C., and Jamestown, N. Y.

sales manager and factory manager working together and with a definite promise on the part of the sales manager that his organization will market the volume decided upon, the office is then in a position to put into operation the first manufacturing orders for the required products.

The form on which manufacturing orders are issued to the factory is shown in Fig. 1. It will be noted that each order calls for a specified number of completed units. Right here a mistake is often made when piece part costs are attempted. In the first place, the production of parts for bedroom and dining room furniture is essentially different than production of parts for chairs. In the latter case the same part may be used for from 25 to 35 different patterns, while in the former case a specific part is hardly ever used but for the unit for which it is designed.

Any attempt made to secure part costs will entail an excessive amount of clerical work on the part of the workers at the machines, will take a large part of the time of the foreman, and will necessitate considerable office expense in compiling a finished cost per unit. As this expense is seldom if ever warranted, all practical purposes are served by using the same order number for all parts which enter into the construction of a particular unit, charging all materials, labor and expense to this order number.

As the schedule of sales is to be set up only for a six months' period on account of the semi-annual markets, the figures for this schedule, in the case of a bedroom furniture plant, are developed as shown in the tables:


FACTORY COPY

ORDER No. 13626

PLANT _____ DEPARTMENT _____ DATE _____

QUANTITY _____ DATE WANTED _____

PATT. NO. _____ PART No. _____ FINISH _____

DESCRIPTION _____

DELIVER TO _____ CHECKED BY _____

OP. NO.	OPERATION	TO FOLLOW ORD. NO.	MCH. NO.	DATE FIN.	PCS. O.K.	PCS. REJ.	OP. NO.	OPERATION	TO FOLLOW ORD. NO.	MCH. NO.	DATE FIN.	PCS. O.K.	PCS. REJ.

ASSOCIATES PRODUCTION ORDER

FIG. 1 MANUFACTURING ORDER
Duplicate, Production Control Copy; Triplicate, Cost Copy.

TABLE 1. SALES VOLUME FOR SECOND HALF OF 1924

MONTH	PER CENT SALES VOLUME	MONTHLY VOLUME DOLLARS
July	18	$ 54,000.00
August	16	48,000.00
September	16	48,000.00
October	20	60,000.00
November	14	42,000.00
December	16	48,000.00
Total	100	$300,000.00

TABLE 2. SALES SCHEDULE FOR SECOND HALF OF 1924

MONTH	BEDS	DRESSERS	VANITIES	CHIFFORETTE	CHIFFOROBES
July	475	475	238	238	239
Aug	423	423	215	213	216
Sept	423	423	215	214	215
Oct	530	530	264	263	265
Nov	370	370	184	186	185
Dec	423	423	215	213	216
Total	2644	2644	1331	1327	1336

In the preparation of such sales schedules it has not been found at all difficult to get the sales manager to state definitely the volume of sales which his organization will secure over a given period. When it comes to making a statement as to what sales can be expected each month, the average sales manager is entirely at sea. A detailed analysis made of past sales will disclose two important facts which are necessary before sales estimates can be converted into figures that will be of use to the manufacturing end of the business. These facts are:

1. The percentage that each month's sales volume bears to the total sales volume for the period to be scheduled.
2. The relative quantity of each unit to be sold, as the basis for specifying monthly requirements of each article for the period.

Table 2 shows the figures worked out for the plant in question, based upon the sales manager's promises and an analysis of past sales, and converted into figures that the factory was able to use. With these figures agreed to by the sales manager and the factory manager, the basis for co-ordinating sales and production was established. Follow-up then became a matter of reflecting current performance against the schedules to see that accomplishment measured up to the advance planning that had been done.

Purchasing to Meet Requirements

As purchased materials entering into the manufacture of bedroom and dining room furniture represent from one-fourth to one-half of the total cost, the need for adequate purchasing and stores control is obvious. In woodworking as in many other industries, there is often a tendency on the part of executives to indulge in speculative purchasing. This is especially true in those plants where modern management methods have not been introduced and where, instead of purchasing against known requirements, such requirements are assumed or guessed at.

Another serious error arises when the manager does all of the purchasing and where he is prejudiced against employing the same kinds and grades of materials as his competitors. Recently in one plant the writer

found the manager buying red gum at $52 per 1000, while his principal competitors were using sap gum and paying $40 per 1000, treating the processed product to a different staining operation in the finishing. As this plant consumed 6000 bd. ft. of lumber per day, it did not require much argument to effect the change and save the $20,000 per year which had been paid for the manager's pride of opinion.

Experience has shown that in purchasing for the average-sized furniture plant it is best to place the purchase of lumber in the hands of the general manager, at the same time providing him with full details as to quantities required, amount on order, stock on hand. The manager is in closer contact with the progress of sales, knows the market and can frequently make advantageous purchases of this commodity, whereas the purchasing agent will be inclined to action limited by his personal knowledge of conditions.

When sales and production programs are set up, it is essential that such stores control be established as will provide materials when they are required and at the same time avoid tying up capital which may

STANDARD PURCHASE ORDER

FULLER FURNITURE MFG. CO.
Marion, N. C.
MANUFACTURERS
OF
BEDROOM AND DINING ROOM FURNITURE

Purchase Order No. 13426

To

Shipping Instructions

Conditions of Purchase

Quantity	Description	Price	Amount

Acknowledgment of Order — Purchase Order No. 13426

Fuller Furniture Mfg. Co.
Marion, N. C.

Date

Gentlemen:

The Goods Covered by this Purchase Order will be shipped according to your instructions on or before _____

Vendor Company _____

By _____

Note: Unless this slip is filled in with a definite promise date and returned to Vendee promptly, this is not a valid contract.

FIG. 2 STANDARD PURCHASE ORDER

be otherwise needed for carrying on the operations planned.

There are certain losses which are incurred by the average furniture manufacturing plant in the South, which, because they have not been carefully analyzed and studied, are looked upon as "necessary evils" and a part of the risks of the business. These are interest charges; depreciation and deterioration of excess purchases; the cost of delaying production because materials are not at hand when required; and loss through materials being used for purposes other than those for

PURCHASE REQUISITION

PURCHASE REQUISITION
FORSYTH FURNITURE CO.
1997

_____ 192__

TO THE PURCHASING DEPARTMENT:
PLEASE PURCHASE THE FOLLOWING AND CHARGE TO _____

DELIVER TO PLANT _____ LOCATION _____

SUGGESTED SOURCE OF SUPPLY _____

DATE WANTED _____ DATE ORDERED _____

WRITTEN BY _____ APPROVED BY _____

PURCHASE ORDER NO. _____ POSTED TO STORES RECORD BY _____

FIG. 3 PURCHASE REQUISITION

INSTRUCTIONS REGARDING HANDLING OF PURCHASE REQUISITIONS

PURPOSE:

1. For the purpose of securing control of all purchases for the company, purchase requisitions will be written to cover all requirements for materials, supplies, equipment, office and factory furniture, stationery, printed matter, and all materials and supplies for the maintenance of, or additions to, the company's buildings, equipment, etc.

FORM:

2. All department heads will provide themselves with purchase requisition blanks, as shown above, which may be obtained from the stationery clerk in the office. These requisitions are bound in pad form, in triplicate, and are serially numbered in sets.

WRITTEN AND SIGNED BY:

3. Any person may write and sign a purchase requisition who is authorized to do so by the head of a department, but each requisition must be countersigned by the head of the department or by the head of the production control department.

APPROVAL BY:

4. All purchase requisitions will be written in triplicate. The original and duplicate copies will be forwarded to one of the following divisions for approval, then forwarded to the purchasing department. The triplicate will be held by the writer.

(a) All requisitions calling for material and supplies required for production orders, also materials and supplies for the maintenance department, will be approved by the head of the production control department.
(b) All requisitions for special tools, machinery, equipment, shop furniture, and for outside labor, will be approved by the factory manager.
(c) All requisitions for office furniture, equipment, printing and stationery, will be approved by the general manager.
(d) All requisitions for advertising, photographs, catalogs, cuts, etc., will be approved by the general manager.

ACTION AFTER APPROVAL:

5. When requisitions have been approved by any of the foregoing parties, both the original and duplicate copies will be forwarded to the purchasing department. In any case where approval is not given, both copies will be returned to the party making out the requisition, with notation as to why purchase cannot be made.

WRITING PURCHASE ORDER AND FILING REQUISITION:

6. When requisitions, properly signed and approved, are received by the purchasing department, it will issue purchase orders to cover them, noting on the original and duplicate copies of the requisition the name of the vendor, purchase order number and date ordered. The original requisition will be filed in the purchasing department, according to date. The duplicate copy will be sent to the stores and material clerk, who will file it according to purchase order number, this number being first entered on the stores record card.

INFORMATION ABOUT DELIVERIES:

7. When anyone in the factory operating departments desires information about delivery of materials on requisition, he will inquire of the storekeeper. In case the material has not been received, the storekeeper will fill out a material shortage slip and forward to the production control department. If immediate information is needed, call the stores clerk on the shop phone. When other departments want information about deliveries, etc., they will inquire of the purchasing department, referring to the date and number of the purchase requisition.

EMERGENCY PURCHASES:

8. A certain amount of emergency purchases will be made locally. In no case can these exceed $25 for any single purchase. In every case a purchase requisition must be sent through, showing the details, with note that material has been received.

(Signed) CHAS. L. JONES,
General Manager

which they were procured. A simple and effective stores and material control plan has been found to eliminate these losses and to pay its cost many times over in the savings which it produces.

In many plants the purchasing agent considers that he has performed his full duty when he has placed the purchase order. When this assumption is allowed to stand, there can be no allocating of the responsibility for the sales and production programs which have been set. Unless the purchasing function carries with it the responsibility for getting materials delivered in time to meet the factory's needs, but little can be accomplished.

The Purchase Order, a copy of which is shown in Fig. 2, has been found to meet the needs of just this situation. When it is sent to the vendor it is accompanied by a letter calling attention to the conditions of the contract and the fact that it does not constitute an order unless the perforated promise slip is returned.

The success of this plan has been found to rest largely upon training the vendor concerns to understand that definite production schedules have been set up, based on receiving materials at the time specified. Generally they will be found not only willing but anxious to co-operate. Where a concern is found that will not furnish the desired information or that will not co-operate, the purchasing agent has but one recourse—to find another source of supply.

The source from which the purchasing department obtains its information as to material requirements is the purchase requisition, which, with the instructions for its use, is shown in Fig. 3.

This purchase requisition is made out by the stores clerk who is located in the production control department, and is based upon the data contained on the stores record card, shown in Fig. 4.

Stores control methods, in addition to correct purchasing routine and the proper operation of the storeroom itself, require that the following steps be taken:

1. Establish a "minimum" for each article of material, supplies, and other item to be controlled.
2. Establish a "quantity to order" for each.
3. Provide a method of reserving materials for orders in process or orders planned but not started.
4. Set up stores accounts in the general ledger, which will control the purchase and issue of materials and will not be merely a "history record."

When it has been explained to them, executives will quite generally agree on the desirability of the foregoing. But when their active assistance is asked to help set the "minimum" and "quantity to order" they invariably counter with the statement that they cannot look so far ahead. However, there are certain factors which determine these figures for each item of stores, and if materials are divided into two classes, these factors can be determined and rapidly applied in any specific case.

First, take those factors which apply generally to all materials which are purchased. These factors are the general condition of the business and the schedules which have been worked out for the future manufacturing program. As these facts are known, their value in terms of what is going to be needed is a matter of simple calculation. In every case these factors should be reduced to definite quantity figures before calling upon the chief executive to exercise his judgment in the establishing of controls.

Then take those factors which apply to specific materials, such as the time between placing an order and the receipt of the material; the receiving date with reference to the time when materials will be required; whether or not materials are carried in stock by the vendor; and the need of securing quotations from several sources before materials can be ordered at satisfactory prices. Definite information as to each of these points must be at hand before beginning the task of setting up the control figures.

In actual operation in a plant employing less than 150 workers and doing an annual volume of business in excess of $600,000, it has been found that the clerical work required to operate a satisfactory stores and material control routine is about four hours daily time of one girl.

Her work in this connection includes the following:

1. Entry of all receipts of materials, supplies and finished stock on the stores record card.
2. Entry of all disbursements of materials, supplies and finished stock on the stores record card.
3. Computing balance on hand with each entry as made above.
4. Pricing all stores requisitions covering stores issued, before turning over to cost clerk.
5. Writing up all purchase requisitions which the condition of balance of stores requires.

(To be continued in the October issue.)

STORES & STOCK RECORD

Symbol

Name_____
Material_____ Size _____
For _____
Source of Supply _____

Unit

Part No. _____
Weight _____ Spec. No. _____
Quantity To Order _____

Date								
Minimum								

1. Ordered				2. Received			3. Issued				4. Applied			5. Available		6. Balance on Hand		
Date	Quant	Req No	P.O. No.	Date	Quant.	Cost	Date	Quant.	Order No.	Cost	Date	Quant.	Order No.	Date	Quant.	Date	Quant.	Value

FIG. 4 STORES RECORD CARD

Manufacturing Procedure Simplified

A Complete Cycle of Orders and Returns for Both Shop and Office Functions

By JOHN R. BANGS

Instructor of Industrial Engineering, Cornell University

IN all forms of human endeavor, procedure must be recognized and dealt with. In some lines the methods may not be definitely thought out and the results will be accordingly inefficient. Take the football team for example. All during its training period it is drilled and trained along definite lines of procedure. When the signals are called, every man proceeds according to a definite plan, the guards and tackles making the holes, the backfield men acting as interference and advancing the ball. When signals "go bad" and the method of procedure is unbalanced, the team as a rule huddles together to map out a play. and we have the so-called "huddle play" which the spectator dislikes, because he recognizes that the smooth working of the machine has been temporarily, at least, disrupted.

Procedure a Medium for Efficiency

In certain professions, law, for instance, a person must proceed along definite lines if he wishes his case to be recognized. In the history of a trial the first step is to serve a summons on the defendant, thereby notifying him of an impending action, in which he is the defendant. The plaintiff then files a record of his complaint, which contains a concise statement of facts constituting his cause of action. The defendant answers with a statement of arguments contesting the truth of the facts in the plaintiff's complaint, or presenting additional facts to offset the liability charged. These pleadings define the nature of the action and theory of the respective cases for the court and the parties themselves. Omissions or errors in the sequence of this procedure would confuse and delay litigation. Similarly, a manufacturing plant may be nicely organized, equipped with all the necessary personnel to turn out a product, but unless it has definite lines of procedure mapped out, it is as helpless as a layman in court, or a varsity football team without signals.

Recognizing these principles, all well organized and administered plants have definite lines of procedure mapped out, along which all orders flow to authorize the doing of certain work, and all returns flow back to indicate the performance of the work and the costs involved.

That such methods of procedure are not simple is readily understood when visiting a representative factory, and observing the care with which the product is planned to suit the particular purpose, and the great number of forms involved in carrying out this plan.

There are, however, certain fundamentals that are observed in all good manufacturing procedure, and it should be recognized that the many systems in effect are merely different ways of applying fundamental principles.

In the teaching of industrial engineering at Cornell University we have long recognized the difficulty of presenting clearly to the student these fundamental principles. The instructor in charge is often confronted with such remarks as "In father's shop we write a requisition," etc., and "In the General Electric Company they use, etc."

The question naturally arises: Cannot the answer to these questions be found in text books, and current literature on the subject? Experience has taught us that this is difficult to do, because most literature on industrial engineering deals with the description of some particular system, so that the student minus the fundamentals of the subject finds himself hopelessly lost in a mass of detail. As a result of trying to clear up the atmosphere, and to present a straight-forward, workable scheme illustrating the fundamental principles as conceived by Taylor and his associates, the diagram in Fig. 1 was constructed.

Separation of Office and Shop Functions

In this diagram all office functions are shown above the heavy horizontal line and all shop functions are shown below it. Full lines indicate the paths of orders and instructions moving downward from the office to the shop, while dotted lines indicate the paths of records and returns moving upward to the office from the shop.

It represents the complete manufacturing cycle, beginning with the sales order down to the workman on a particular machine working on the part in process. As soon as the men start working on the product, returns flow up into the cost department, where the cost of the product is compiled. Further cycles might be built up about the various departments, which would carry one into all possible branches and devices used in manufacturing and control today.

When an inquiry comes to the sales department for duplicate work of standard construction, a price is set and quoted the customer. If the inquiry is in regard to new work, it is sent to the engineering department for design and estimate. If a certain date

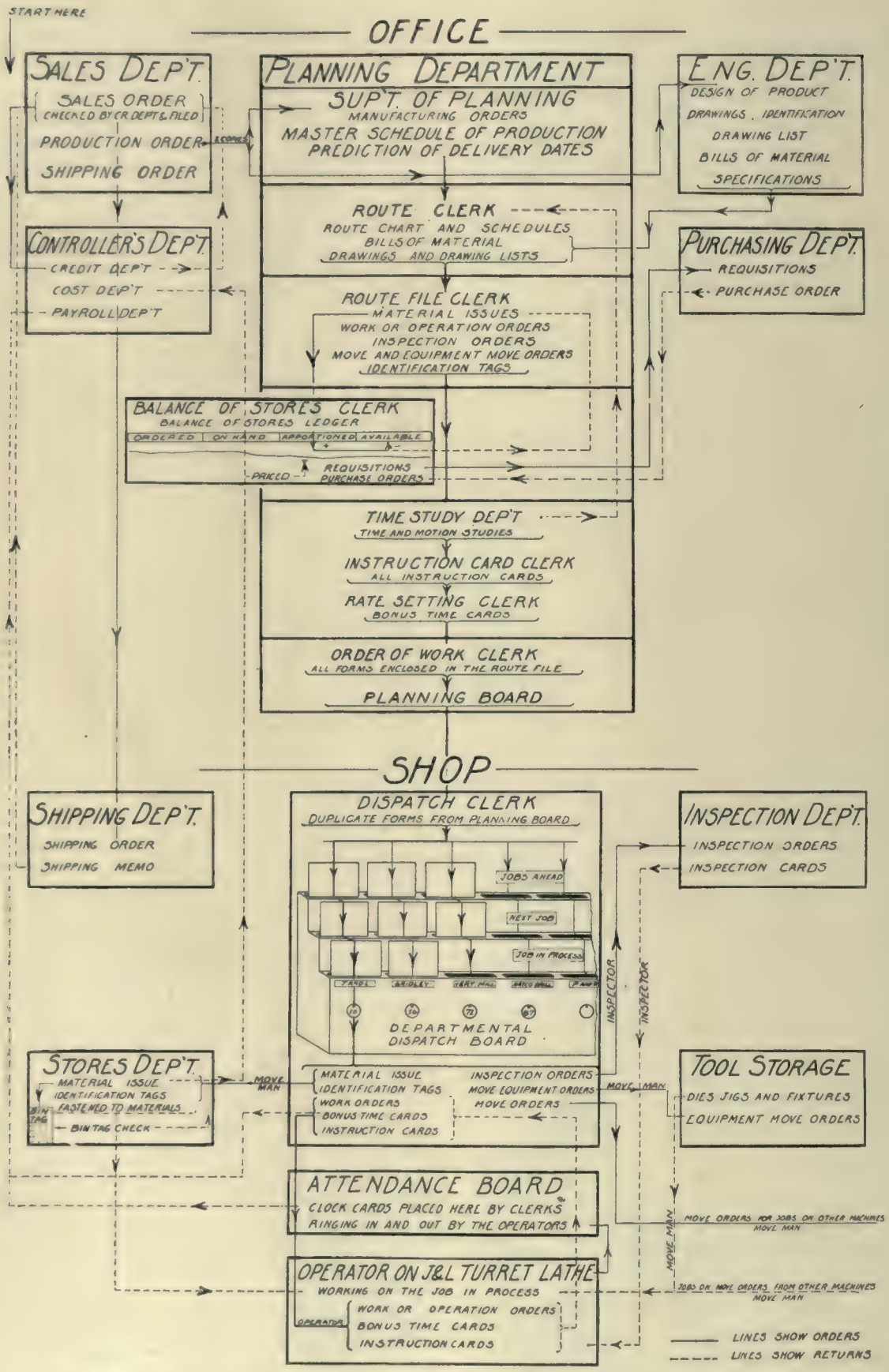


FIG. 1 THE FUNDAMENTAL PRINCIPLES OF MANUFACTURING PROCEDURE AS CONCEIVED BY TAYLOR AND HIS ASSOCIATES

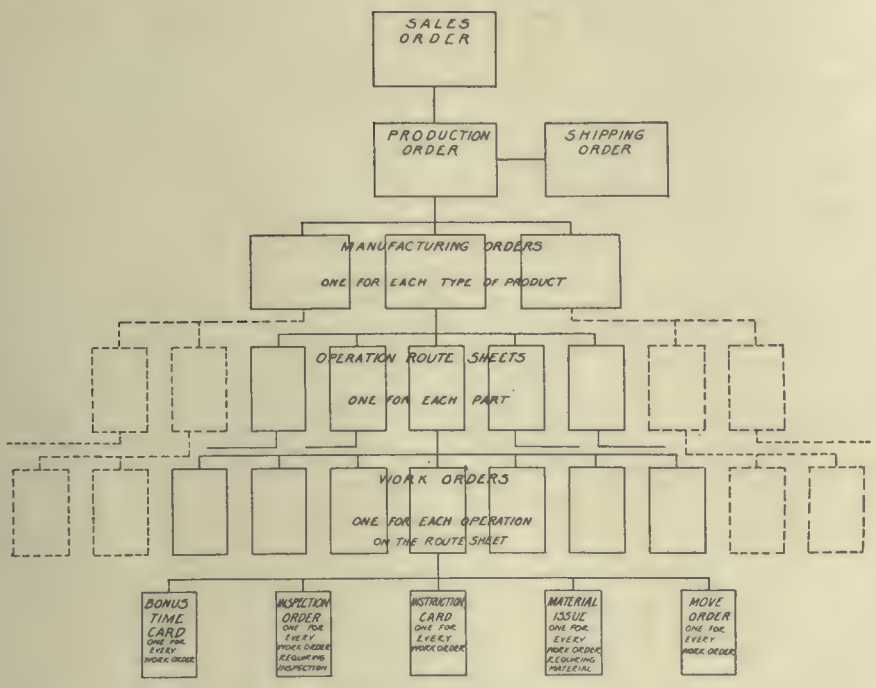

SALES ORDER
PRODUCTION ORDER
SHIPPING ORDER
MANUFACTURING ORDERS
ONE FOR EACH TYPE OF PRODUCT
OPERATION ROUTE SHEETS
ONE FOR EACH PART
WORK ORDERS
ONE FOR EACH OPERATION ON THE ROUTE SHEET
BONUS TIME CARD ONE FOR EVERY WORK ORDER
INSPECTION ORDER ONE FOR EVERY WORK ORDER REQUIRING INSPECTION
INSTRUCTION CARD ONE FOR EVERY WORK ORDER
MATERIAL ISSUE ONE FOR EVERY WORK ORDER REQUIRING MATERIAL
MOVE ORDER ONE FOR EVERY WORK ORDER

FIG. 2 SEQUENCE OF FORMS USED, FROM SALES ORDER TO INSTRUCTION CARD

of delivery is specified, the planning superintendent and his assistants are consulted before making a promise in regard to delivery.

Starting, then, in the upper left-hand corner of the diagram, it is assumed that the sales order, Fig. 3, has been made out on the authority of the customer's purchase order. After the sales order or the customer's purchase order has been received by the sales department, it is sent to the credit department to check terms and the financial status of the customer. The sales order having been suitably approved, the simplest and most up-to-date method of putting it into production is to make a number of copies of the sales order, the number varying according to the size of plant and complexity of the product. In our case we are assuming the original sales order and 4 carbons: a shipping order, a production order, an order to the engineering department, and one to the cost department, respectively.

The sales order itself is filed in the sales department with memoranda as to prices, terms, etc. The shipping order is sent to the shipping department, where it is held until the finished materials or goods come through for shipment. The copies to the planning and engineering departments now start the real sequence of events that culminate with the shipping of the product.

On the authority of its copy, the engineering department now designs the product, assuming that it is not standard, and sends the drawings, drawing lists, bills of material and specifications down to the route clerk.

In the planning department the production order is analyzed. The superintendent of planning or the production manager may divide the production order into a number of manufacturing orders (see Fig. 2). Manufacturing orders are made out for each separate type of machine or kind of work, each order referring back to the production order number. For instance, the sales order might call for two boring mills type 24 H., two boring mills type 16 H., and two 50-ton O. E. T. cranes. There would be made out, in this case, three separate manufacturing orders. The production superintendent now fits the time necessary to build his machines into his master schedule of production, so as to predict accurately the delivery dates of all work going through the shop. This may take the form of a great detailed plan such as the Franklin schedule board devised by G. D. Babcock at the H. H. Franklin Manufacturing Company, Syracuse, N. Y., or a Gantt chart as applied in many plants by Wallace Clark. Or it may be very simple, consisting only of a series of dates, and controlled by a card index or by some of the modern systems such as the Kardex, Rand Visible, etc.

The Route Sheet

With the aid of the engineering department's data and the production superintendent's plan, the route

THE CORNELL TRANSMISSION CO.
Ithaca, N. Y., U. S. A.
SALES ORDER

SOLD TO *Yellow Cab Co., Inc.* — No. *546*
ADDRESS *1337 South Ave., Chicago, Ill.* — CUSTOMER'S No. *B-374*
CREDIT APPROVED *C. E. R.*
PROMISED *May 1, 1925*
DATE REC'D *Apr. 10, 1925*

QUANTITY	DESCRIPTION	SYMBOL	SHIPPING WEIGHT	UNIT PRICE	AMOUNT
350	Transmission	YC-4	16750	96.00	33,600.00
			16750		33,600.00

COPIES TO ENGINEERING DEP'T, PLANNING DEP'T, COST DEP'T, SHIPPING DEP'T

SHIP TO *Premier Cab Co.*
ADDRESS *775 Broadway, New York, N. Y.*
VIA *Freight* CHARGES *Collect*
SPECIAL INSTRUCTIONS *Insure for full value, Ship via L. & W. R. R. Car 404736.*

T. E. Simonton,
Sales Manager.

FIG. 3 SALES ORDER (ACTUAL SIZE 8½ IN. x 11 IN.)

ROUTE SHEET

PART NAME *Idler Gear* No. *25*

SYMBOL *G-3* CHARGE TO *E-183*

MATERIAL *Nickel-Steel Casting* DATE TO BE STARTED *Apr. 14, 1925*

No. WANTED *350* DUE IN FINISHED STOCK *May 6, 1925*

SPOILAGE *10* SCHEDULED BY *D. W. Wild*

OPER. NO.	NO. OF PIECES	DESCRIPTION	MACH. NO.	MACHINE NAME	DUE AT MACHINE	COMPLETED	REMARKS
1	360	Bore and Face 1st Side	6	J & L	Apr. 14	Apr. 16	
		Inspect					
2	356	Broach oil groove	22	Broach	17	17	
3	356	Hand ream bore	—	Bench	18	18	
4	356	Turn O.D. & Face 2nd Side	6	J & L	19	21	
		Inspect					
5	354	Block teeth	57	B. & C. Hob	22	25	Delayed to Rush B-53.
6	354	Finish cut teeth	47	Shaper	23	30	
		Inspect teeth					
7	354	Point one side	36	Pointer	28	May 1	
8	354	File corners	37	S. Lathe	28	1	
9	354	Roll teeth	39	Lathe	28	1	
		Inspect					
10	354	Harden, Carbonize,			28		
		Quench, Reheat, Draw		Heat			
11	354	Sand-blast, Polish for		Treating			
		Brinell test. Test teeth		Dept			
		with file				May 4	
12	354	Grind bore	72	Heald	May 2	7	
		Final Inspection			May 5	8	Passed 352. J. P. W.

FIG. 4 ROUTE SHEET (ACTUAL SIZE 8½ IN. x 11 IN.)

clerk is in a position to route the work through the shops intelligently. He makes out route sheets, one for each part (see Figs. 2 and 4) and sets scheduled times for them to arrive at the various machines in the shop, either from his own experience or from information supplied by the time-study department. This important step completed, the route sheets with their attendant drawings, drawing lists, etc., go to a clerk commonly called a route file clerk, really an assistant to the route clerk. This person writes out, as shown, most of the major orders, which include the material issue, work order in duplicate or triplicate, as the system may require, inspection orders, move orders and identification tags.

Balance of Stores Ledger

In most modern systems all orders go through a balance-of-stores ledger, which keeps a running inventory of all stores. Accordingly it is very important that the material issue be first sent to the balance of stores clerk, who adds the material called for to the Apportioned column and subtracts it from the Available column (see Fig. 5). Should the available fall below the minimum, he immediately sends in a requisition to the purchasing department for more material of this kind.

The conclusion of this article, in the October issue, completes the cycle of orders and returns for both shop and office functions. It includes the issuing and return information from the purchasing order, the work order, the material issue, the bonus time card, the inspection order, and the instruction card.

BALANCE OF STORES

ORDER IN QUANTITIES OF *2500*

DESCRIPTION *Idler Gear* WHEN AVAILABLE SHOWS *1000*

SYMBOL *G-3* LOCATION IN STORES *F-36*

ORDERED BUT NOT YET DELIVERED			DATE REC'D	ON HAND IN THE STOREROOM					APPORTIONED TO AN ORDER BUT NOT YET ISSUED FROM STORES				AVAILABLE THAT IS: ON ORDER AND ON HAND		
DATE ORDR'D	PURCHASE ORDER NO.	QUANTITY		QUANTITY	DATE ISSUED	ISSUED TO ORDER NO.	TOTAL COST	UNIT COST	DATE APP.	QUANTITY	APP. TO ORDER NO.	DATE DUE IN STORES	DATE	QUANTITY	REMARKS
				1300					4-11	360	E-183	4-13	4-11	940	
4-11	C-827	2500											4-11	3440	
				940	4-14	E-183				—					
		—	4-19	3440			675.00	.27							
									5-7	740	G-36	5-9	5-7	2700	
				2700	5-9	G-36				—					
				2720	5-13								5-13	2720	

FIG. 5 BALANCE OF STORES LEDGER SHEET (ACTUAL SIZE 8½ IN. x 11 IN.)

Legal Pitfalls in Marketing Products

Illustrations of "Hairline" Decisions

By GILBERT H. MONTAGUE

Of the New York Bar

"IT IS absolutely dishonest," said William E. Humphrey, a recently appointed member of the Federal Trade Commission, speaking before the Chamber of Commerce of the United States in May 1925, "to claim that there is a clear and distinct line between what is and what is not unlawful under the anti-trust acts. It is, therefore, absolutely dishonest to say that, when they are violated, it is always done purposely. It is absolutely dishonest to say that when men violate the anti-trust acts, their action is always as reprehensible and that it is done as knowingly as when men violate laws that for ages have been recognized by common consent without statutes. The Supreme Court of the United States has many times been divided upon what action constituted an unfair method of competition. How can it honestly be contended then, that business men know with certainty?"

Government prosecutions under the anti-trust laws and the Federal Trade Commission Act present many illustrations of the truth of Commissioner Humphrey's statement.

In 1914, Congress enacted the Federal Trade Commission Act, which declared that "unfair methods of competition in commerce are hereby declared unlawful," and created the Federal Trade Commission to enforce this Act.

Premiums for Salesmen

Many business men believe that it is unfair for a manufacturer to obtain preference for the sale of his products by giving to the salesmen of his distributors or dealers any cash or premiums, such as neckties, knives, watches, silverware, umbrellas, hats, diamonds, jewelry, or other rewards, as inducements for such salesmen to push the sale of that manufacturer's products to the exclusion of the products of the latter's competitors. This practice has, indeed, been frequently denounced in trade journals and before trade conventions, and in several trade associations has been the subject of strong, condemnatory reports and resolutions. It was not surprising, therefore, that early in its career the Federal Trade Commission instituted a number of prosecutions against manufacturers in many different industries who were engaging in this practice. Finally, however, one of these manufacturers appealed from a Federal Trade Commission order to the Circuit Court of Appeals which held, in 1921, that this practice was entirely lawful, so long as it was carried on with the knowledge and the consent of the distributors and dealers who employed these salesmen.

Resale price standardization is another subject that has abounded in "hairline" decisions. From 1906 to 1918, the Supreme Court of the United States, in a long series of decisions on which the justices of the Supreme Court were sharply divided, held that various agreements, copyright restrictions, patent restrictions, notices and other arrangements to prevent price-cutting and to enforce resale price standardization were all unlawful and forbidden by the anti-trust laws.

Resale Price Control

In 1919, however, the Supreme Court unanimously held, in a government proceeding against a well-known soap company, that in the absence of any intent to create or maintain a monopoly, the anti-trust laws do not prevent a manufacturer from announcing in advance the prices at which his goods may be sold, and refusing to deal with distributors and dealers who do not conform to these prices.

Relying upon this Supreme Court decision, the Circuit Court of Appeals, in a case where another manufacturer was appealing from a Federal Trade Commission order, unanimously held, in 1920, that the Commission was not authorized in forbidding the manufacturer to refuse to sell to distributors because the latter had sold, or were selling, to price-cutters, nor in forbidding the manufacturer "to secure the co-operation of these distributors in maintaining or enforcing any such system of resale prices."

In 1922, however, upon an appeal by the Federal Trade Commission from this Circuit Court of Appeals decision, the Supreme Court held, in an opinion from which four justices dissented, that it was unlawful for this manufacturer to carry into effect its resale price standardization policy by "co-operative methods" in which the manufacturer, "and its distributors, customers and agents undertake to prevent others from obtaining the company's products at less than the prices designated by it: (1) By the practice of reporting the names of dealers who do not observe such resale prices; (2) by causing dealers to be enrolled upon lists of undesirable purchasers who are not to be supplied with the products of the company unless and until they have given satisfactory assurances of their purpose to maintain such designated prices in the future; (3) by employing salesmen or agents to assist in such plan by reporting dealers who do not observe such resale prices, and giving orders of purchase only

to such jobbers and wholesalers as sell at the suggested prices and refusing to give such orders to dealers who sell at less than such prices, or who sell to others who sell at less than such prices; (4) by utilizing numbers and symbols marked upon cases containing their products with a view to ascertaining the names of dealers who sell the company's products at less than the suggested prices, or who sell to others who sell at less than such prices in order to prevent such dealers from obtaining the products of the company; or (5) by utilizing any other equivalent co-operative means of accomplishing the maintenance of prices fixed by the company."

Resale Price Difficulties

Most of the perplexities now existing in the law regarding resale price standardization arise from this decision. The Supreme Court, it will be observed, concedes that any manufacturer may, in the absence of any intent to create or maintain a monopoly, announce in advance the prices at which his goods may be sold, and may refuse to deal with distributors and dealers who do not conform to these prices. But in the decision last quoted, the Supreme Court emphatically holds that no one, in the exercise of this right, must ever avail himself of any of the means described in the decision above quoted, although without the use of some of these means it is exceedingly difficult for anyone ever to exercise this indubitable right.

Great though the difficulty is, it nevertheless is possible in many instances to exercise one's right to refuse to sell without using any of these forbidden means. This was strikingly illustrated in December 1924 in a federal court case where, after listening to the government's evidence in a resale price standardization case, the judge directed the jury to return a verdict of not guilty, stating that the manufacturers on trial "may not sell or refuse to sell to their dealers in any such way as shall involve an agreement with the dealers, a combination or a conspiracy with them," and if these manufacturers "were involved in any restrictive measures which had to do with other and like dealers, a very different face would be presented," and "if after the cutting off of their customers there were solicitation on their part asking for reformation, nothing else but an agreement could be interpreted," but that since none of these forbidden acts had been proved, the manufacturers "can refuse, wheresoever they will, to sell to this man or that man. They can sell to whomsoever they please, or they can refuse to sell to whomsoever they please."

To the cases already discussed, one more "hairline" decision may be added. After long continued disputes between the building trade unions and the building industries in San Francisco, the Builders Exchange of San Francisco was organized in 1921, with a membership of more than 1000 building contractors and dealers in building materials, to co-operate with the Industrial Association of San Francisco, which had been organized by a committee of the San Francisco Chamber of Commerce for the purpose of combating the building trade unions. The principal means adopted was the "permit" system, the object of which was to limit sales of certain specified kinds of materials to builders who supported the plan. To render this restriction effective, the person concerned was required to obtain a permit from the Builders Exchange, specifying the kinds and quantities of materials to be furnished, and the particular job on which they were to be used. The materials specified were cement, lime, plaster, ready-mixed mortar, brick, terra-cotta, clay products, sand, rock and gravel.

In 1923, the Federal Court in San Francisco enjoined the Builders Exchange and the Industrial Association on the ground that their operations were a conspiracy in restraint of interstate commerce in violation of the Sherman Act. From this decision, the Builders Exchange and the Industrial Association appealed to the Supreme Court of the United States, and in April 1925, the Supreme Court reversed the decision of the federal court in San Francisco, on the ground that the operations of the Builders Exchange and the Industrial Association did not constitute a restraint of interstate commerce.

The Supreme Court remarked that most of the products in respect of which permits were required were "California productions, and were deliberately selected for that reason, in order to avoid interference with interstate commerce." Although plaster, in large measure produced in other states and shipped into California, was on the list, the Supreme Court stated that "the permit requirement was confined to such plaster as previously had been brought into the state and commingled with the common mass of local property, and in respect of which, therefore, the interstate movement and the interstate commercial status had ended."

The lower federal court in San Francisco in its decision in 1923 had "laid especial stress upon the point that plumbers' supplies, which for the most part were manufactured outside the state, though not included under the permit system, were prevented from entering the state by the process of refusing a permit to purchase other materials."

Influence of a Local Situation

To this contention, the Supreme Court in its decision in April 1925 replied that "the alleged conspiracy and the acts here complained of spent their intended and direct force upon a local situation—for building is as essentially local as mining, manufacturing or growing crops—and if, by a resulting diminution of the commercial demand, interstate trade was curtailed either generally or in specific instances, that was a fortuitous consequence so remote and indirect as plainly to cause it to fall outside the reach of the Sherman Act."

From the Maple Flooring Manufacturers' decision, the Cement Manufacturers' decision, the premium decision, the resale price standardization decisions, and the Industrial Association decision, it is plain that only a "hairline" separates legality from illegality in many cases in the law of marketing arising under the anti-trust laws and the Federal Trade Commission Act.

Practical Lot Quantity Formulas

By GEORGE F. MELLEN

Assistant Professor of Industrial Engineering, Pennsylvania State College

THE article, "A Practical Lot Quantity Formula," in the June issue of this magazine, gives a formula developed by an employee of the General Electric Company for the purpose of determining the most economical ordering quantity. This formula is:

$$Q = \sqrt{\frac{400\,RA}{C}}$$

Where Q = Economical lot quantity, expressed in thousands
R = Rate of consumption per month, expressed in thousands
A = Set-up and preparation cost
C = Cost per 1000 parts

A formula of this kind should not be used indiscriminately without knowing its derivation and limitations.

The cost of an article, at the time it is used, is composed of three elements: Cost of set-up, unit manufacturing cost, and cost of carrying in stock from the time of completion until needed for use. The cost of set-up is separated out in order to eliminate the variation in unit manufacturing due to the size of the lot manufactured. If, having eliminated this variable, we assume the unit manufacturing cost to be constant, the most economical lot to manufacture will be that size lot for which the sum of the carrying charge per piece and the set-up cost per piece is a minimum. The set-up cost for a given article may also be assumed to be constant. The quantity to order then depends upon the relation between consumption rate, set-up cost, unit cost, and the rate of the carrying charge. The other factors being equal, this quantity will vary if the carrying charge rate is changed. This rate should include both interest on investment and a storage charge. Obviously, the proper rate to use will vary from plant to plant and should be determined individually in every case.

The fact that this rate is not set up as an independent variable in the formula given limits its usefulness.

An article, "Determining the Production Quantity," by W. E. Camp, published in the January 1922 issue of *Management Engineering*, gives the development of an analytical formula on the basis outlined above. This formula, in a slightly modified form to make it more general in application, is:

$$Q = \sqrt{\frac{2\,RS}{nC}}$$

Where Q = Ordering quantity
R = Yearly consumption in pieces
S = Set-up cost of order in dollars
n = Carrying charge rate
C = Cost per piece

This formula is of general application, since the value of n may be varied to fit individual conditions.

The first formula above is identical with the Camp formula worked out with a 6 per cent carrying charge. Thus, substituting in Camp's formula, $n = 0.06$, and other values in terms of the first formula, $R = 12{,}000\,R$; $S = A$; $C = 1000\,C$; we have

$$Q = \sqrt{\frac{(2)\ 12{,}000\,RA}{(0.06)\ 1000\,C}} = \sqrt{\frac{400\,RA}{C}}$$

Distributing Steam Costs Correctly

By HAROLD E. RAMSEY

Superintendent, Power Department, Atlantic Refining Co.

I HAVE read with considerable interest Walter N. Polakov's articles in the May and June issues of this magazine on the subject of power cost distribution. If I correctly interpret his distribution of costs in the article "Allocating Power Costs to Product," it appears that the users of live steam are required to pay 66 per cent of the cost of electric generation, in addition to the cost of their steam, this charge being deducted ultimately from the price of exhaust steam to be charged against the consumer of that product. This will, no doubt, have the effect for which it is designed, viz., to create or at least encourage the demand for exhaust steam in processes where it can be used as a substitute for live steam. It does not, however, in my opinion give the thing which is equally important to the company—a correct allocation of the actual costs of steam and electricity production against the processes or products which actually entail these expenses. It, therefore, becomes misleading as to the real costs of producing the several products, which may lead to just as real a loss in marketing as the loss of exhaust steam in producing. It is my belief that the economies to be realized through the use of by-product exhaust steam or by-product electric generation, whichever way the saving is regarded, can be, and should be, realized by the definite adoption by the engineering management of the use of exhaust steam in all processes where it can be profitably utilized, and that this policy should not be left to the fancy of the foremen. It will thereby become unnecessary to reduce artificially the price of exhaust steam in order to secure its utilization.

I do not quite agree with Mr. Polakov's statement in note 3, page 553, that a loss of 3 per cent of the fuel value will occur in reducing the steam pressure through reducing valves. The heat content per pound of steam on the low pressure side of the reducing valve is the same as on the high pressure side, neglecting radiation losses, and the B.t.u. which are in excess of the heat content of saturated steam at the lower pressure are present as superheat if the steam was dry on the high pressure side, or as re-evaporated moisture if it was wet.

Mr. Polakov's articles present in a very convincing manner the size of the savings which are possible in a great many industrial processes today where they are at present little realized.

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 100 magazines; it also includes the publications of some 50 book publishers and professional societies so far as these are of managerial interest to manufacturing executives. The number at the right of each item is the index symbol according to the Dewey Decimal Classification System. If articles are clipped and filed according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. The books and pamphlets indexed can be procured from the Management Publication Corporation or from their respective publishers. Photostat copies (white printing on black background) of any magazine article indexed can be obtained at a *price of 25 cents the page*, by addressing the Engineering Societies Library, 29 West 39th Street, New York City. Remittance must accompany the order. When ordering photostats please quote from the index: (1) Title of article; (2) Index number; (3) Name, date, and page numbers of periodical in which the item appears. The editors will be glad to furnish on request additional information in regard to industrial buildings and equipment, and the management of manufacturing industries.

Industrial Buildings and Plant Maintenance

Buildings and Equipment

Better Illumination in Industrial Plants. 658.24
Roy A. Palmer. *Industrial Engineer*, August 1925, pp. 363-365, 402. Illus. With discussion of results obtained in increased production and reduced accident hazards.

Bloedel-Donovan New Diamond "B" Box Factory at Bellingham, Washington. 658.23
Barrel and Box, July 1925, pp. 37-38. Illus. Capacity increased 50 per cent; all materials mechanically handled; direct connection motor drive for machines.

Do We Build to Burn? 658.284
Virgil G. Marani. *Pit and Quarry*, July 1, 1925, pp. 73-77. Construction methods to prevent fire in fireproof, slow burning, ordinary masonry, and wood buildings, and use of gypsum in each case for fireproofing.

Industrial Ventilation as Applied to Harmful Dusts, Gases and Fumes. 658.25
John Roach. *Safety Engineering*, July 1925, pp. 52-56. Discussion of various methods from the standpoints of economy and effectiveness.

Modern Manufacturing Plant. Kelley Press Division of the American Type Founders Co. 658.23
John F. Fallon. MANAGEMENT IN MANUFACTURING, September 1925, pp. 119-124. Illus. New plant is largest automatic printing press factory in the world. Its construction and equipment, which are described, show the new tendencies in manufacturing buildings.

Solving a Factory Location Problem. 658.21
A. G. Anderson. *Industrial Management*, July 1925, pp. 21-24. Lamp post factory investigates location of markets and sources of raw material, with corresponding freight costs, before deciding on site.

Trinity's Fort Worth Plant a Notable Achievement. 658.23
Cement, Mill and Quarry, July 20, 1925, pp. 9-14. Illus. From the quarry to the sack loaded on the car, this cement mill employs only 14 distinct operations.

Twin Cities Plant of the Ford Motor Co. 658.23
Benjamin M. Cowan. *Stone and Webster Journal*, July 1925, pp. 61-72. Illus. Description of the St. Paul works, consisting of a manufacturing plant 1400 x 600 ft., a hydro-electric plant, and a steam power plant for standby and heating service.

Maintenance and Repair

Attacking the Utility Sector of Factory Overhead. 658.58
Norman L. Sammis. *Industrial Management*, July 1925, pp. 33-38. Stopping the wastes of power, heat, light, water and compressed air.

Practical System for Handling Mechanical Department Job Orders. 658.58
H. F. Scott. *Power*, August 4, 1925, pp. 160-162. Illus. Methods of the Dennison Manufacturing Co. in keeping track of orders for work for the upkeep of equipment for power, light, heat and process steam, and also for the maintenance of buildings and equipment.

Separating Dust from Air in Industrial Plants. 658.58
Charles L. Hubbard. *Industrial Engineer*, August 1925, pp. 366-372. Illus. Equipment and methods of operation.

General Management and Policy

Administration and Policy

Getting the Most Out of Your Machine Tool Dollar. 658.27
T. C. Vail. *American Machinist*, July 30, 1925, pp. 175-176. The author, who is superintendent of the Spicer Manufacturing Corporation, sets five years as the extreme limit of useful life of the average machine tool.

"What Will It Do to Our Capital Ratio?" 658.14
W. A. Layman. *System*, August 1925, pp. 153-158. Illus. The author, who is president of the Wagner Electric Co., emphasizes the importance of the effective use of capital, illustrating his point of view by numerous illustrations. He offers 10 points to watch in working for better capital ratio.

Economics

Facts About Working Women. 331.4
Bulletin No. 46, Women's Bureau, U. S. Dept. of Labor. 64 pp. Charts. Graphic presentation showing proportion and distribution, nativity, marital condition, hours of work, and wages of working women in the United States.

Invention Viewed from the Technical and Patent Rights Standpoint. 608
Richard Wirth. *Zeitschrift des Vereines Deutscher Ingenieure*, July 25, 1925, pp. 969-974. (In German.)

Regularization of Employment. 658.311
H. Feldman. Harper & Bros., New York. 427 pp. $3.50. This book is an outgrowth of a research report prepared in the fall of 1921 for the President's Unemployment Conference. The time was too short for a complete study and at the suggestion of Sam A. Lewisohn, President of the American Management Association, it was continued under the auspices of that society. The chapter headings are: Growing Insecurity of Employment; Social and Industrial effects of Irregular Employment; The New American Emphasis in the Attack of Unemployment; A Technique of Regularization; Control of Demand Through Research; Diversifying the Output; Simplification and the Style Problem; Changing Customary Purchasing Habits; Some Important Principles of Scientific Sales Planning; Planning Production Within the Plant; Labor Policies That Steady Employment; Systematic Training and Transfer Within the Plant; Construction, Coal Mining, Longshore, Farming; Co-ordination in the Labor

Market; Unemployment Compensation and Insurance; A Comprehensive Program of Regularization.

Taxation as a Blow to Industry. 336.2
Garrard B. Winston. *Stone and Webster Journal*, July 1925, pp. 17-23. Address by Under-Secretary of the Treasury, on effects of inheritance and income taxes, delivered before the convention of the National Association of Credit Men.

The Reds: Are They a Real Menace to American Industry—III. 335
Ralph E. Duncan. *Iron Trade Review*, July 9, 1925, pp. 70-72. Illus. The mechanism of the Red movement. IV. Ralph E. Duncan, July 16, 1925. Illus. The Socialist war on business. V. Hermine Schwed. July 23, 1925, pp. 189-191. Illus. How they put it over in men's and women's clubs. VI. Margaret C. Robinson. July 30, 1925, pp. 243-246. Illus. The youth movement, its deceptive nature and vicious tendencies. VII. Corydon B. Hopkins. August 6, 1925, pp. 303-305, 311. Illus. How the evils of radicalism are being introduced into churches, colleges and schools.

Trend of Engineering Wages Since 1850. 331.2154
Robert Spicer. *World Power*, July 1925, pp. 34-40. Study of wages in the metal industries with special reference to cost of living and price level, past, present and future.

Wages and the Family. 331.21
Paul H. Douglas. University of Chicago Press, Chicago. 281 pp. $3. This book presents the proposal of the author for the application of the living wage principle in industry. He starts with the general theory that men and women should be paid enough to maintain themselves on at least a physical basis of life. However, he does not accept the standard family of five, and believes that under the present structure of society it would be impractical to pay each adult male worker enough to support a family of five and that this unsound, impractical situation would undoubtedly exist under both Socialism and Communism. Briefly, his proposal is to pay variable wages for the same work, according to the needs of the worker and his family. That is, a single man would receive enough to maintain him, plus a margin to permit saving for marriage, and a married man would receive additional allowances to meet the extra expense of providing for his wife and children. The development of this proposal occupies the first 43 pages of the book. The balance is given over to a presentation of fact matter in regard to the family allowance system, which is in force in some form in most of the Continental European countries. The volume closes with a discussion of the objections to the proposed system.

Management

Basic Allowance and Tolerance System. 658.562
W. L. Hindman. *Machinery*, August 1925, pp. 933-937. Illus. Important features of uni-bilateral system, and practical advantages as compared with other systems.

Capitalizing the Advantages of the Small Factory—IV. 658.5
Dale S. Cole. *Industrial Management*, July 1925, pp. 40-45. Charts. Importance of product to the small shop.

Efficiency of Heating Furnaces. 658.5:669.1
E. H. Koenig. *Iron Trade Review*, July 30, 1925, pp. 249-253. Charts. Comparison of performances of continuous and intermittent types indicates duties for which each is best fitted, and should influence design.

Handwriting on the Wall. 658.571
Arthur D. Little. *Industrial and Engineering Chemistry*, August 1925, pp. 857-858. Imperative need for continual scientific research in all branches of manufacturing.

Laboratory Tests as Promotional Assets. 658.562
O. A. Wiepking. *Cement, Mill and Quarry*, July 5, 1925, pp. 60, 62, 64, 66. Advantages in directing work of developing and manufacturing product and convincing the user about its merits. Special reference to concrete.

Linking Science and Industry. 658
Edited by Henry C. Metcalf. Williams & Wilkins Co., Baltimore. 206 pp. $3.50. This volume consists of 16 essays on the application of the humanistic sciences to the art of business management. The authors are well known in their respective fields and the scope of their papers is indicated by the following list of topics and authors: New Tendencies and Problems in Business Management, by H. S. Person; Executive Initiative and the Formulation of Sound Personnel Policies, by E. K. Hall; Nature's Administrative Methods, by William Patten; The New Task of Personnel Management, by Alvin Johnson; Man and Men, by Cassius J. Keyser; Personnel: The Outstanding Problem of Public Administration, by William E. Mosher; The Measurement and Control of Human Behavior, by Robert M. Yerkes; Health and Efficiency in Industry, by C. E. A. Winslow; Industrial Psychiatry, by C. Floyd Haviland; Intelligence Versus Reason in Personnel Administration, by James Harvey Robinson; The Problem of Controlling Wages, by Walton H. Hamilton; The Evolution of the Labor-Capitalist Class, by Thomas Nixon Carver; Co-operative Arrangements Between Management and Workers on a Railroad, by George Soule; The Relation of European Conditions to American Business Management, by Harold G. Moulton; Revolutionary Radicalism in American Labor, by Benjamin Stolberg; Periodic Planes of Creation, by Robert B. Wolf.

Making a Success of the Small Manufacturing Business. 658
C. U. Carpenter. MANAGEMENT IN MANUFACTURING, September 1925, pp. 125-128. Outline of critical points which may bring early failure to a small manufacturing business. The subjects covered are product, selling, advertising, patents, capital and expansion. Truths most interestingly told.

Management Problems in the Automotive Industry. 658
Harry M. Jewett and James H. Collins. Bulletin of the Taylor Society. August 1925, pp. 190-195. The automobile industry has passed from the era of development to that of stabilized merchandising. This means that engineering and production are becoming fixed, while distribution is the dominant immediate factor.

Manufacturing Procedure Simplified. 658.5
John R. Bangs, Jr. MANAGEMENT IN MANUFACTURING, September 1925, pp. 149-152. Graphical outline of the functions and orders in manufacturing procedure of the Taylor system together with the records which flow back after the orders have been executed.

Modern Equipment Brings Low Costs. 658.2
MANAGEMENT IN MANUFACTURING, September 1925, pp. 117-118. A plea for greater attention on the part of manufacturers to their equipment, for the reason that advances made since 1920 make many plants and much machinery unprofitable. Particular attention is called to modern factory buildings and building construction, material handling machinery, power equipment, and fixed equipment, which establishes and maintains working conditions.

Steel Foundry Management. 658.5:669.1
R. A. Bull. *Mechanical Engineering*, August 1925, pp. 653-657. Outline of organization including departmental functions with particular emphasis on compensation for foremen and workmen.

Successful Methods for Increasing Sales and Balancing Production. 658
Charles F. Scribner. MANAGEMENT IN MANUFACTURING, September 1925, pp. 145-148. Methods used by southern furniture plants to increase sales, purchase materials and balance production.

Unique Invoicing Form Perfected. 658.773
K. D. Cassidy. *Michigan Manufacturer and Financial Record*, August 1, 1925, p. 5. Ford Motor purchasing department's system saves much clerical work, and is adopted by 500 other firms.

Power Generation and Transmission

Fuel

Clean Coal: How to Get It—IV. 621.18222
Ralph H. Sweetser. *Iron Trade Review*, July 16, 1925, pp. 134-137. Illus. Mine owners, coke producers and iron and steel manufacturers are co-operating for the purpose.

Properties and Value of Coals. 621.182
Hans Tropsch. *Zeitschrift des Vereines Deutscher Ingenieure*. July 4, 1925, pp. 899-903. Illus. (In German). How the evaluation of coal for industrial purposes and distillation to obtain by-products depends upon knowledge of its combination and composition.

Selection of Fuel Oil Storage Facilities. 621.182
R. Kraus. *Forging — Stamping — Heat Treating*, July 1925, pp. 250-251. Illus. Underground pit conserves space and gives fire protection. Steel tank to be preferred.

Power Equipment

Combined Power and Heat Installation. 621.18
F. Niethammer. *Zeitschrift des Vereines Deutscher Ingenieure*, June 27, 1925, pp. 861-866. Illus. (In German.) Layouts, utilizing multistage turbines, suitable for textile and sugar industries, where high pressure steam is needed for power, and low pressure for heat and processing.

Electrical CO_2 Apparatus. 621.197
World Power, July 1925, pp. 49-53. Illus. Description of Cambridge Instrument Co. meters, indicating and recording, and their effect on fuel economy.

Engine Lubricating Systems and Their Care. 621.195
A. B. Newell. *Oil Engine Power*, June 1925, pp. 342-344. Illus. Selection of proper oil and methods of keeping it free from grit and of cleaning the engines.

Installing Oil Circuit Breakers. 621.31736
Industrial Engineer, August 1925, pp. 373-378. Illus. Electric Power Club's instructions for installing breakers and power switching equipment, and their operation and care.

Layout of Overhead Electrical Circuits. 621.3122
J. Elmer Housley. *Industrial Engineer*, August 1925, pp. 358-362. Illus. Layouts in industrial plant yards, considered from the standpoints of continuity of service, safety to workmen, cost of maintenance, and general appearance.

Maintenance of Air Compressor Efficiency. 621.51
F. H. Ryan. *Power House*, July 5, 1925, pp. 27-28. Illus. Value of 2-stage compression. Good lubrication, suction screen, and care of governors important.

Methods of Coal and Ash Handling. 621.18378
Power Plant Engineering, August 1, 1925, pp. 785-786.

Modernizing a Paper-Mill Power Plant. 621.18
Power Engineer, July 1925, pp. 263-268. Illus. Large economy brought about by new high-pressure steam plant at the Chartham Paper Mill of W. Howard & Son, Ltd.

Overhauling a Diesel Engine. 621.4
M. S. Howard. *Power House*, June 20, 1925, pp. 24-25, 42. Illus. Suggestions on adjustments and remedying wear.

Turbine and Boiler-Room Auxiliaries. 621.197
G. G. Bell. *Universal Engineer*, July 1925, pp. 20-23. Requirements for reliability, variable speed drives, types of motors, effect of availability of main unit on auxiliaries.

Power Plant Operation

Care of Motors for Better Results. 658.26
J. J. Curtin. *Canadian Woodworker and Furniture Manufacturer*, July 1925, pp. 51-52. Inspection, lubrication, cleaning; importance of correct air gap; planning machine groups.

Figuring Steam Requirements for Combined Bleeder-Mixed-Pressure Turbine. 658.26
J. Y. Dahlstrand. *Power*, July 14, 1925, pp. 42-45. Convenient methods of determining steam consumption for various conditions of load and demands for process steam.

Increasing Exhaust Fan Efficiency. 658.26
C. C. Herman. *Canadian Woodworker and Furniture Manufacturer*, July 1925, pp. 50-51. How to keep power consumption low.

Power Economies Through Load Dispatching. 658.26
Henry A. Richardson. *Industrial Management*, July 1925, pp. 1-4. Illus. Smoothing out the peaks and drops in the factory power demand.

Power From Blast Furnace Gas. 658.26
C. H. S. Tupholme. *World Power*, August 1925, pp. 90-93. Illus. Data on the practice and results of operation in representative plants.

Power Generation by Blast Furnace Plant. 658.26
O. C. Callow. *Iron and Steel Engineer*, June 1925, pp. 242-246. Illus. Data and tables of results based on Trumbull Cliffs Furnace Co. practice.

Power Transmission

Belting and Transmission in U. S. Air Mail Plant. 658.262
W. H. Mack. *Belting*, July 1925, pp. 28, 30. Illus. Superintendent finds good use for scraps of belting, and designs own coal conveyor.

Transmission and Conveying in Modern Furniture Factory. 658.262
W. A. Scott. *Belting*, July 1925, pp. 13-14. Illus. Various types of drive used in Doernbecher Mfg. Co. plant, involving 250 motors and hundreds of feet of transmission and conveyor belting.

Marketing and Distribution

Advertising

Best Results Can't Be Tabulated. 659.1
M. F. Behar. *Class*, August 1925, pp. 18, 20, 22. Written from the experience of the C. J. Tagliabue Manufacturing Co., which is that the inquiries directly developed by advertising are the least important effect of advertising.

Co-operative Advertising Will Help Solve Industry's Problems. 659.1
Fred G. Taylor. *Candy Factory*, August 1925, pp. 44-46. A study made in many fields reveals surprising growth of trade as a result.

How a Manufacturer Helps to Sell Customer's Product. 659.13
Stanley M. Cooper. *Belting*, July 1925, pp. 34, 36, 40. Illus. Method of using customer's name in business. Advertising by parts manufacturer can create prestige and good will. Based on Fafnir Bearing Co. practice.

Principles of Advertising. 659.1
Harry Tipper, Harry L. Hollingworth, George Burton Hotchkiss, and Frank Alvah Parsons. The Ronald Press Co., New York. 473 pp. Revised edition. The soundness of the original plan of this book has been demonstrated by 10 years of use. It has received the approval of practitioners, teachers and students of advertising. The present work is a complete revised edition without, however, any important modification of the original basic plan. The rewriting has become necessary because of the progress of science in the field of advertising, as well as the necessity of introducing new illustrative material representative of present-day advertising practice.

Selling

Dangerous Selling Prices. 658.8
W. L. Churchill. MANAGEMENT IN MANUFACTURING, August 1925, pp. 79-82. A forceful discussion of the danger of too low prices on the one hand and too high prices on the other, reinforced with many typical cases. A cure for dangerous prices is suggested by extending a knowledge of industrial economics to manufacturers and disseminating information in regard to trade conditions.

Developing Sales Personality. 658.807
Elmer E. Ferris. Prentice-Hall, New York, 157 pp. $2. Second edition. A straight-forward discussion, based on 6 years' practical experience, of the four basic elements of a successful sales, or professional, or business, personality: Affirmative mental attitude; vital energy; intellect; and personal contacts. Two additional chapters take up the latter subject in this edition under the headings: The Art of Conversation, and How to Judge and Handle Men. The author states that if a man of fair ability will address himself with a reasonable degree of earnestness to the development of the four basic elements, his success in selling will be assured.

Market Analysis: Its Principles and Methods. 658.808
Percival White. McGraw-Hill Book Co., Inc., New York. 438 pp. Illus. $4. Second edition. In this revision of the first edition published in 1921 many changes and additions have been made in the text in order to keep in step with the rapidly advancing technique of market analysis. The basic principles given in the earlier book and still retained in the present volume have for the most part proved sound in present-day practice and the detailed applications of those principles as outlined in this edition have been used successfully by many

able workers in the field. This book will be as valuable today as the earlier volume was four years ago.

Pitfalls in the Law of Marketing. 658.8
Gilbert H. Montague. MANAGEMENT IN MANUFACTURING, September 1925, pp. 153-154.

Trimming Sales Cost to Meet Today's Competition. 658.8
William R. Basset. *Advertising and Selling*, July 29, 1925, pp. 15, 16, 38, 40, 42-44. Expresses the opinion that the high costs of selling are largely due to the manufacturer.

Wholesale Organization in the Automobile Industry. 658.86
Clare Elmer Griffin. *Harvard Business Review*, July 1925, pp. 424-435. Descriptions and analysis of advantages and disadvantages of the two types of systems in use for the wholesale distribution of automobiles.

Shipping

Do Your Cost and Performance Records Reflect the Quality Trucks in Your Fleet? 656
Martin J. Koitzsch. *Motor Transport*, July 1925, pp. 24-26. Tables. Geo. W. Bush and Son Co. find that records check up drivers and trucks, detect irregularities, show operating costs, and advise as to replacement.

Export Packing of Some Miscellaneous Commodities. 658.78842
J. F. Keeley. *Barrel and Box*, July 1925, pp. 19-21, 43-45. Illus. Methods successfully used by leading U. S. exporters of hardware, small tools, office supplies and equipment, etc.

Machines for Mass Packaging. 658.7884
Kurt W. Geisler. *Zeitschrift des Vereines Deutscher Ingenieure*, July 11, 1925, pp. 917-922. Illus. (In German.) Packaging, wrapping and bag filling and sealing machines. July 25, 1925, pp. 981-984. Illus. Tube filling and sealing, and carton filling and wrapping machines.

Utilizing Reserve Power. 656.124
H. C. Freuhauf. *Motor Transport*, July 1925, p. 32. Illus. Use of trailers to employ reserve power of auto trucks, based on experience of the Habirshaw Electric Cable Co.

Material Handling and Production Control

Material Control

How to Save Money in the Lumber Yard. 658.78
H. S. Bartholomew. *Wood Working Industries*, July 1925, pp. 28-29, 36. Illus. A systematic arrangement for locating and piling lumber, with reliable records, keeps inventory down to an economical basis. August 1925, pp. 20-21, 36. Best methods of storing and handling.

How We Keep Straight on 20,000 Items of Stock. 658.78
C. Willis Adams. *System*, August 1925, pp. 185-190. Illus. Methods used in plant of the Link Belt Co. to show how many pieces of any one of 20,000 items are on hand at any time. Stock shortage is completely avoided.

Human Element in Material Control. 658.78
Charles A. Williams. *National Association of Cost Accountants Official Publications.* August 1, 1925, 9 pp. Accounting is not merely applied mathematics. Its value lies in the interpretation of the results of business operation expressed in measured quantities. The human element enters in all such analysis and the relation of this factor to the accounting for material control is outlined.

Organizing the Tool Crib Personnel. 658.563
Anker L. Christensen. MANAGEMENT IN MANUFACTURING, September 1925, pp. 141-144. Control of tool crib operation by means of written standing orders. Qualifications and duties of the various members of the working force and their organization for effective service.

Mechanical Handling

Belting and Conveyor Equipment in Non-Metallic Industry. 658.281
Belting, July 1925, pp. 20, 22, 24, 26. Illus. Labor-saving equipment in several large plants on the Pacific Coast represent importance to non-metallic industries.

Conveyor System Cuts Costs. 658.281
Iron Age, August 6, 1925, pp. 336-338. Illus. Description of equipment installed by the Interstate Foundries, Inc., which resulted in reduction of over 50 per cent in foundry floor space without reducing the molding capacity.

Conveyors Speed Radiator Casting. 658.281
R. J. Heisserman. *Iron Trade Review*, August 6, 1925, pp. 310-311. Illus. Mechanical equipment at the plant of the Richmond Radiator Co. reduces payroll over 50 per cent.

Hyatt Methods of Material Handling. 658.281
H. J. Forsythe. MANAGEMENT IN MANUFACTURING, September 1925, pp. 137-140. Illus. Equipment and plant layout adopted after a careful study of the requirements for mass production of a number of small parts of high quality. Savings accomplished in handling sand, refuse, etc.

Pit and Quarry Transportation Methods. 658.281
G. B. Massey. *Pit and Quarry*, July 15, 1925, pp. 43-46. Illus. Loading, hauling and dumping methods, with comparative costs.

Savings Result from Joint Operation of a Cement and Lime Plant. 658.281
E. D. Roberts. *Pit and Quarry*, July 1, 1925, pp. 45-52. Illus. Layout of plant and material handling features of the Sun Portland Cement Co.

Studies in Mold Handling. 658.281
Iron Age, July 30, 1925, pp. 272-274. Illus. Arrangements and layout of conveyors or cars which carry the molds, and are shifted to molding, pouring and shakeout positions. From the brass foundry of the Speakman Co., Wilmington, Del.

Three Level Handling Condenses Foundry Operations. 658.281
Foundry, August 1, 1925, pp. 593-597. Illus. Arrangement of foundry of the Cadillac Motor Car Co. for the handling of all materials and finished castings.

Production Methods and Control

Drafting Room Practice. 621.75
Harold D. Way. *Buildings*, July 1925, pp. 228-230. Time, team work, detailing, accuracy, notes, arrangement on drawings.

Inspecting and Testing Automobile Axles. 658.562
R. L. Rolf. *Forging—Stamping—Heat Treating*, July 1925, pp. 226-231, 240. Illus. Every possible test used to make the finished part absolutely dependable. Columbia Axle Co. practice.

Passenger Car Scheduling System. 658.513
Joseph Gullage. *Railway Mechanical Engineer*, August 1925, pp. 502-505. Forms. Increases shop output and reduces working force, under competent supervision, on the Boston and Maine Railroad.

Production Methods in a Tractor Plant. 658.561
Machinery, August 1925, pp. 951-954. Illus. Typical operations illustrating quantity production methods for agricultural and industrial tractors at the Chicago works of the International Harvester Co.

Principles of Lumber Drying. 658.5:674
Thomas D. Perry. *Woodworking Industries*, July 1925, pp. 33-36. Illus. Underlying fundamentals. August 1925, pp. 25-27, 36-37. Illus. Kind of kiln to buy is determined by kind of stock used.

Employment and Personnel Management

Employment and Training

Keeping Tabs on the Apprentice. 658.386
H. A. Frummelt. *Iron Age*, July 23, 1925, pp. 208-209. Methods used by Milwaukee Metal Trades to record progress of young men in the shops.

Participation of the Public Schools in Apprentice Training. 658.386
American Management Association, New York. Pamphlet. 32 pp. Symposium of five papers with following titles: Apprenticeship—a Public School as Well as An Industrial Problem; An Adequate National Apprenticeship Program Must Make Use of the Public Schools; Principles Governing Co-operative Schools; Adjustment of Industry's Apprenticeship Methods Into a Co-operative Program; Co-operative Apprenticeship—A Solution.

Personnel

Foreman and His Responsibility. 658.31243
John H. Linn. *Railway Mechanical Engineer*, August 1925, pp. 496-498. Successful management, planning, use of materials and machinery, relations with men.

Our Men Like to Work. 658.3225
Oatis Wilcox. *Brick and Clay Record*, July 7, 1925, pp. 32-35. Illus. Methods of the Alliance Clay Products Co. to visualize production and stimulate interest of their employees. A bonus is distributed, based on the earnings of the company, and a silver loving cup and a prize of $1000 is awarded to the plant having the best record.

Practical Solution of an Industrial Problem. 658.3254
Harold A. Ley. *Safety Engineering*, July 1925, pp. 26-29. Plans under which employer and employee share in paying for life and sickness insurance and health service.

Selecting the Salaried Employee—II. 658.3115
Eugene J. Benge. *Industrial Management*, July 1925, pp. 16-20. Forms. Employment methods of the Atlantic Refining Company.

Safety

Exit Drill Code for Industrial Establishments. 658.382354
Safety Engineering, July 1925, pp. 35-39. Portion of Report of Committee on Safety to Life, National Fire Protection Association, on building exits code.

How Production Methods Aid Machine Shop Safety. 658.3823
A. K. Dean. *American Safety News*, August 1925, pp. 25-26. The author, who is superintendent of the American Laundry Machinery Co., declares that safety and production are inseparable and that the plant organized for efficient production is of necessity safe.

Industrial Poisonings by Aromatic Compounds. 658.3823
D. H. Killeffer. *Industrial and Engineering Chemistry*, August 1925, pp. 820-822. Types of poisoning, prevention, first aid, skin affections, duties of management to introduce precautionary measures.

Putting a Premium on Safety. 658.3823
John Nelson. *Iron Age*, July 30, 1925, pp. 269-270. Illus. Experience and record of the American Steel and Wire Co. in reducing accidents in their plants.

Safety and Efficiency in Chemical Plant Design. 658.3823:66
W. H. Kiler. *National Safety News*, August 1925, pp. 11-14. Outline of the important factors in the design of a safe and efficient chemical plant, based on the experience of the Hercules Powder Co.

Safety Organization for the Small Plant. 658.3823
Carl B. Auel. *National Safety News*, August 1925, pp. 17-19. Plan of organization was developed for the Department of Labor and Industry of the State of Pennsylvania.

Accounting and Financial Control

Accounting and Cost Finding

Cost Accounting in the Lumber Industry. 657.452:674
A. L. Carson. *Official Publication of the National Association of Cost Accountants*, July 15, 1925, pp. 1-23.

Distribution of Overhead Charges in Locomotive Shops. 657.452
W. A. Jones. *Railway Mechanical Engineer*, August 1925, pp. 513-515. Cost per hour to operate a machine suggested as accurate basis on which to distribute total overhead costs.

Mathematics of Accounting. 657
A. B. Curtis and J. H. Cooper. Prentice-Hall, Inc., New York. 388 pp. $5. This book is a treatise on short-cut methods for calculations frequently arising in the work of both private and public accountants. Begins with simple arithmetical processes, addition, subtraction, multiplication, division, continues through fractions, percentage, interest, averages, and takes up the fundamentals of algebra and algebraic equations, including logarithms, logarithmic charts and progressions. A chapter is devoted to each of these topics: Compound interest, ordinary annuities, special annuities, bond and bond interest valuation, asset valuation accounts, building and loan association accounts. A feature of each chapter is worked out problems, and in numerous cases examples are given for solution by the reader. The book appears to possess much valuable information although much of it is easily available from other sources.

Methods of 42 Manufacturers in Distributing Expenses to Product. 657.452
Charles Reitell. MANAGEMENT IN MANUFACTURING, August 1925, pp. 87-92. Methods used by 42 manufacturers in handling selling and administrative expenses divided into four groups: (1) Do little or nothing; (2) General ratio method; (3) Budget and effort method; (4) Special method. The second group is the most numerous, followed closely by the first, while only a few firms have adopted the third and fourth.

Financial Control

Bell Telephone System Budget Plans. 658.14
C. A. Heiss. MANAGEMENT IN MANUFACTURING, September 1925, pp. 133-136. Methods which provide a working basis for co-ordinating activities of the operating divisions of the Bell Telephone System. Accuracy of budgets is shown by 1924 experience. Gross additions to plant exceed estimated by less than 5 per cent; telephone revenue and receipts varied from estimates less than 1 per cent.

Financing of Coal Companies. 658.14
Robert K. Cassatt. *Coal Mine Management*, July 1925, pp. 43-50, 54-55. Magnitude of industry, nature of financing not for operating more mines, standards for coal investments, bonded indebtedness, labor situation, advantages of mergers.

New Industrial Equipment

Recording Pyrometer. 621.1977
Uses charts 7 in. wide, with rectangular co-ordinates. Instrument makes a single record, a duplex record, or, in multiple form, as many as 12 records on one chart. A pointer depressed every 30 secs. on inked ribbon on the front side of chart makes a continuous line. Pointer in single duplex recorders moves back after each mark, leaving entire chart visible. Charts and ribbon last 2 months before renewal is required. Platen enables pen or pencil notes to be made on chart. Glass knife permits paper to be torn off 2 hr. after last desired impression is made. Indicating scale with large figures also provided. Accurately driven by electric clock on A. C. current, 4 watts per hr. consumption, or by hand-wound block. Standard chart speed, ½ in. per hour., but combinations from ¼ to 6 in. per hr. are available; 12 in. of chart visible at once. Reroll attachment winds up chart where continuous record is wanted. Multiple recorder has non-corrosive provision for contacts, different color recording combinations, and a dial for indicating the thermocouple being recorded at any time. Simple construction, no solenoids, no motors, galvanometer and chart mechanism on hinged frame. Mounted in die-cast, black-enameled, aluminum case 15 in. high., 14 in. wide, 9 in. deep. Made by Brown Instrument Company.

Lift Truck Platform. 621.86
Birch, oak, or maple tops, mortised, if desired, and bolted between heavy angles. Flat head bolts used, flush with surface and fitted with lock washers. Heavy strap iron feet. Lumber 1⅛ in. thick for 3000 lb. loads, and 1⅜ in. thick for 5000 lb. loads.

New Model Dolly Truck. 621.86
This new model dolly truck made by the Marion Tool Works is 6¼ in. off the floor, will handle loads up to 5000 lb., can turn in its own length, and is made in two widths—20 and 25 inches.

Aluminum Rules. 621.9
Two rules, known as "Regular English Rule" and "English Vest Pocket Rule," have the characteristics of lightness, rigidity, black figures and graduations, and freedom from corrosion are made by the Rustless Rule Company.

MANAGEMENT
AND ADMINISTRATION IN
MANUFACTURING INDUSTRIES

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The Modern Manufacturing Plant

New Westinghouse Transformer Factories at Sharon Represent the Latest in Industrial Building Practice

By C. H. CHAMPLAIN

Works Manager, Westinghouse Electric and Manufacturing Company, Sharon, Pa.

IN 1922 the production of transformers in the East Pittsburgh plant of the Westinghouse Electric and Manufacturing Company had reached such a large volume that immediate steps became necessary to provide space for an increased output. The indicated expansion of the business showed that something more than temporary provision must be made.

About this time the property owned by the Savage Arms Company at Sharon, Pennsylvania, became the property of the Westinghouse Company. Sharon is a town of over 25,000 inhabitants, 80 miles to the northwest of Pittsburgh. On this property stood several buildings, mainly of one-story construction, which were suitable for quick adaptation to the manufacture of certain types of transformers. These buildings were so located that the erection of additional shops was possible; and more property could be acquired at both ends of the plant. There were adequate railroad facilities, the plant being served by sidings from both the Pennsylvania and the Erie Railroads.

Hence it was decided to make this plant the headquarters for the manufacture of all Westinghouse transformers. The adjacent land available was also purchased to provide ample room for the growth of this division of the company's business. Work was immediately begun to fit out the existing buildings for straight-line production of the various types of transformers manufactured. Plans were also drawn up for additional new buildings to house the departments which could not be provided for in the older building.

The new plant comprises an area of 42 acres. The total floor space of the buildings is over 710,000

FIG. 1 AIRPLANE VIEW OF NEW TRANSFORMER PLANT AT SHARON

sq. ft. About 2000 people were employed up to the time the new buildings were erected, but the additional plant capacity will call for an increase of 1500 in the working force. The product is transformers of the distribution, instrument, and power converter type, reactors and street lighting regulators. The buildings, both new and old, are of steel frame construction with brick walls. One of the new buildings, however, is erected on a reinforced concrete framework with brick walls. It is four stories high. See Figs. 1 and 2.

The roofs of the new buildings are of gypsum slab construction and have ample skylights of clear wire glass. The roof supports consists of triangular steel trusses.

Special fire exits are unnecessary. In Building I, housing manufacturing departments and the main office, there are two enclosed stairways surrounded by brick partitions which give access to all the floors and form thoroughly fireproof exits in case of emergency. The stairways and platforms are of reinforced concrete. The stair treads are of a steel safety type and the railings are composed of plain black pipe. The walls and ceilings of these stairways are painted white, with a wide strip of gray starting at about a foot from the floor and extending up 3 ft. This serves to receive stains resulting from traffic and to preserve the generally neat appearance of the walls without too frequent necessity for painting. The white strip at the bottom is to encourage cleanliness on the stairs.

The new buildings have considerably more window area than the old and, although the type of construction is the same, the increased daylight admitted is very marked. Windows are of steel sash construction with 14 by 20 in. factory ribbed glass. Wire glass is not used except in the skylights and where exposure to adjacent structures introduces fire risk. The windows in the office are of transparent glass and are fitted with Venetian blinds to admit light but eliminate glare. The ratio of window area to wall area is 75 per cent.

Floors of all the buildings are of concrete, or of wood block or vitrified brick with concrete base. The concrete floors are approximately 9 in. thick, with expanded metal reinforcing, and are poured in blocks of about 15 by 30 ft. with either copper stone or other special finish. The wood block floor consists of a 9 in. thick concrete base with 2 in. wood block laid flat ways, the joints being filled with asphalt. Vitrified brick floors consist of a 9 in. thick concrete base with regulation size brick laid flatways on a ½ in. sand cushion. The bricks were laid with $\frac{3}{16}$ in. joints, filled with cement grout. All office floors are covered with ¼ in. battleship linoleum.

The wood floors were adopted in the reinforced concrete building on account of their fire resisting qualities and their ability to absorb vibration and noise. The vitrified brick floors were adopted in sections where severe usage was anticipated in connection with mounting of large transformer, on account of their high resistance to abrasion and the ease with which the floor can be repaired in event of breakage.

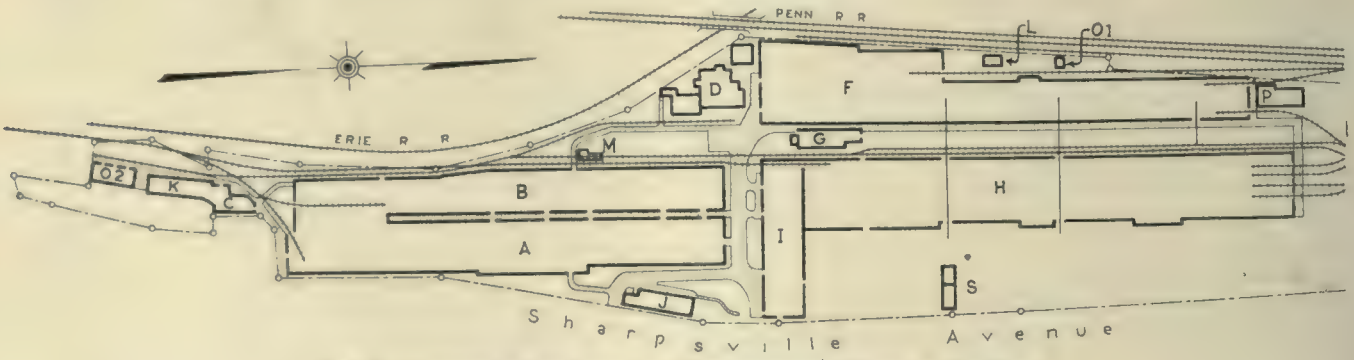

FIG. 2 LAYOUT OF BUILDINGS IN WESTINGHOUSE PLANT AT SHARON

Building	Occupation	Length Feet	Width [1] Feet	Height [1] Feet	Floor Area Square Feet
A	Micarta, Winding, Assembly, Testing, Shipping	940	112	32	109,200
B	Winding, Assembly, Testing, Shipping	960	90	42	96,640
C	1st floor—Box Shop	80	60	32	9,600
	2nd " " "				
D	Power House, Fire Pumps, Air Compressors	125	80	60	10,750
F	Metal Stamping, Tank Welding, Structural Iron	1055	125	56	131,850
G	Maintenance	140	36	28	5,325
H	Assembly, Mounting, Testing, Shipping	1075	148	70	165,500
I	1st floor—Maintenance, Stores, Hospital Mezzanine—Stores, Offices 2nd floor—Office, Tool Room 3rd " —Winding, Cutting 4th " —Winding	352	90	80	133,600
J	Basement—Transformer Engineering Offices 1st floor — " " " 2nd " — " " "	125	42	38	17,350
K	Dry Kiln Room	125	40	28	5,075
L	Acetylene Generating House	50	25	18	1,250
M	Scale House	12	20	..	240
O-1	Oils, Varnish, Benzine	180	40	14	7,200
O-2	Oils in Drums	100	40	20	4,000
P	Insetaire Manufacturing	100	42	20	4,200
S	Storage	140	26	20	3,775

[1] Where widths and heights of buildings are of odd size, due to special projections, averages are taken. One-story buildings include those with balconies and mezzanine floors.

Interior walls and partitions, where permanent, are of brick, painted white, except for the gray strip extending about 4 ft. above the floor to receive the stains which would disfigure a white wall. The underside of the roofs and all the roof trusses are also painted white to take maximum advantage of the daylight.

A very extensive use of partitions has been made within the plant. In most cases these are removable so that any change in operations, or any expansion of departments into adjacent areas, can be taken care of. Permanent partitions, elevator enclosures, and stair enclosures in Building I, are of brick. The others are largely of steel with a dark green baked-enamel finish. These partitions enclose shop offices, processes such as some of the heat treating work, the works engineering department, which is located along the balcony in one of the bays of Building H, wash rooms and toilets, etc. Most partitions are of panel design. Some are entirely of steel while others have glass panes in the upper portions. Between the office and shop there is a 4 in. tile partition.

Interior doors throughout the plant are of fire-resisting type—tin clad over a wood base. Elevator doors, likewise fire-resisting, are of the vertical lift type, separating in the middle—one part rising and the other part lowering—and are counterbalanced.

As the buildings are of fire-resisting construction and in most cases widely separated so that there is no exterior exposure involved, outside doors on practically all of the buildings are of ordinary wood—tongue and groove construction—with glass panels in the top. Most of these doors, except those for freight cars, swing outward instead of running on overhead tracks. Rolling steel doors are used for locomotive and other large entrances.

There are very few stairways except in Building I. Where they do exist, as in the pits of the testing floor in Building H, they are of all-steel construction, with safety treads and pipe handrails, to eliminate fire risk and to lower maintenance charges.

Natural ventilation suffices for all buildings. Upper ventilating sashes in the windows are opened by chain devices. Lower sash ventilators are handled by means of bar and pin operators. Certain processes, such as those for painting, acid baths, etc., are vented by means of hoods and piping leading through the roof. Pneumatic systems are installed in the carpenter shop, etc., to remove dust and refuse. All buildings are equipped with stationary type ventilators, with dampers, spaced at about 100 ft. centers.

For use during winter afternoons, and for any night work that may be necessary, a complete lighting system has been installed. Lamps and reflectors are suspended from the ceiling for a system of direct illumination. In only a few cases has it been found necessary to have localized lighting at individual machines. A three-phase, 60-cycle, alternating current system of 110 volts is employed. In general, 100- to 1000-watt bulbs are used, with metal reflectors painted white inside and green on the outside. A lighting intensity of from 6 to 10 ft. candles has been provided.

A localized heating system has been adopted as standard throughout the plant. Steam is generated in the central power house and there passed through a reducing valve so that when it reaches the local units it is at a pressure varying from 5 to 10 lb. At points down the center of each department the steam is passed through heating coils. These are enclosed in metal casings through which air is circulated by means of large fans. Air from the room is taken in at the bottom of the casing, passes over the steam coils, is raised normally to 65 deg. fahr. temperature, and passes out at the top through ducts which carry it a short distance for distribution. Any portion of this system can be shut off by independent valves when the temperature rises too greatly. Thermostat control has been found unnecessary. The fans are run in the summer to circulate the air and thus cool the shop.

The average number of square feet of radiation in each of these heating units is 1600 sq. ft. This provides 0.02 sq. ft. of radiation per cu. ft. of room volume. The average rate of circulation is 18,000 cu. ft. per min. through the heaters, equal to 3600 cu. ft. of air per person per hr.

On the stairways and in the offices in the main building and throughout the plant, cast-iron wall-type radiators are used for heating. These are likewise locally controlled.

The plant has a separate power house which is used for the generation of steam for heating and manufacturing processes. The major portion of the electric power is purchased from the P. & O. Company power house located at Lowellville, Ohio.

A 12,000 kva. transformer station has been installed at the plant to drop the outside current from a voltage of 66000 down to 6900 and 2200 volts for manufacturing purposes. Three 4000 kva. transformers, single-phase, 60-cycle, have been installed for this service. As the cranes require direct current, three motor-generator sets have been provided in the power house to convert the alternating current. During the summer a motor-driven air compressor is also run.

It was considered economical to use exhaust steam for the heating of the buildings during the winter months, and for this purpose a 1500 kva. A. C. turbo-generator was installed and the exhaust steam turned into the heating lines.

In the winter a steam-driven air compressor is operated and the exhaust from this is also used for heating. The output of the compressor represents almost entirely a direct saving.

The older portion of the power house containing three 475 hp. and one 375 hp. boilers is operated only occasionally, as a reserve unit. In the new end of the power house are two 600 hp. water tube boilers used to generate steam at 160 lb. pressure for processing, and, after reduction, for use in the heating lines. These boilers are fired by automatic stokers driven by small engines.

The heating line returns to the power house are equipped with an automatic vacuum system. The hot water is returned to a hot well and from thence is pumped through a heating tank where make-up water is added. A regulating valve controls the boiler feed pumps and automatically maintains water at the proper level in the boilers.

Natural draft is obtained from two chimneys of yellow tile, one for the old and one for the new section of the power house. The boilers are also equipped with forced draft systems to run them at a higher rating for peak loads. No economizers are used.

An uncontaminated, abundant supply of drinking water is obtained at a depth of 200 ft. The water temperature is between 55 and 60 deg. and consequently no refrigeration is required. The deep well pump for this service is located in the power house.

Two large fire pumps of the reciprocating type are installed in the power house. A complete sprinkler system has been put into the buildings and is under pressure at all times from a large overhead storage tank which also feeds various service lines for industrial processes. River water is used and is delivered to the overhead storage tank by means of centrifugal pumps located in the power house and fed from a pumping station along the river. River water also forms the supply for the fire pumps, but these pumps and also the plant service system can be immediately connected to an ample city supply in case of emergency.

About 40 tons of bituminous coal are burned on an average daily during the height of the winter season, when steam for heating as well as for industrial purposes must be provided. Overhead bunker storage space in the two portions of the power house provides for about 400 tons of coal in each location, a supply ample for three weeks or more of normal operation.

A complete coal and ash handling system serves the power house at a considerable saving over the cost if hand labor were used. The coal is received in hopper cars and is dumped into a track hopper at one side of the power house. It passes down through a chute and into a coal crusher which reduces all lumps to a size convenient for firing. From this point it goes into the boot of a bucket elevator which carries it up 50 ft. into a screw conveyor delivering it to bunkers along the fronts of the boilers. A traveling weigh larry is suspended beneath the bunkers and into this coal is fed, weighed, and discharged through chutes into the hoppers of the automatic stokers.

Ashes are discharged from the back of the stokers and fall into hoppers beneath the boilers. A small dump car on an industrial track is run beneath these hoppers and filled by opening the ash gates. The ashes are taken to a skip hoist which carries them overhead and dumps them into a large receiving bunker directly over the railroad track. Gondola cars are run underneath this bunker, receive the loads of ashes, and then are taken out of the yard to a nearby dump.

Power lines from the sub-station, and covered steam lines for industrial processes and the heating system, are run underground to the various buildings throughout the yards.

Within the various manufacturing departments all power and lighting lines are run, as far as possible, beneath the floors, to simplify layout. In the new buildings all machinery is driven by individual motors, in practically every case mounted on the machines for direct drives. The absence of shafting and belting removes obstruction to vision, interference with lighting, complications of transmission systems, and appreciably increases the element of accident prevention.

TABLE 1. CRANES INSTALLED IN THE PLANT

ELECTRIC TRAVELING CRANES

Location	No.	Capacity	Span
Bldg. A	1	10-ton	58 ft. 0 in.
	1	5- "	58 " 0 "
	3	3- "	29 " 10½ "
	1	2- "	24 " 0 "
	1	10- " + 3- "	58 " 0 "
Shipping	1	5- "	56 " 8½ "
Bldg. B	1	3- "	57 " 4½ "
	4	3- "	27 " 3 "
	1	3- "	38 " 0 "
Yard	1	10- "	70 " 0 "
	1	15- " + 5- "	70 " 0 "
Bldg. D	1	5- "	40 " 3 "
Bldg. F	1	25- " + 10- "	68 " 0 "
	1	10- "	68 " 0 "
Bldg. G	3	5- "	34 " 9¾ "
	2	5- "	51 " 1 "
	1	4- "	23 " 7½ "
Bldg. H	3	15- " + 5- "	56 " 0 "
	2	5- "	Wall crane
	1	30- " + 10- "	80 ft. 0 in.
	1	50- " + 10- "	80 " 0 "
	1	75- " + 15- "	80 " 0 "
Bldg. I	2	3- "	18 " 8 "
	1	5- "	18 " 8 "
	1	1- "	19 " 0 "
	2	½- "	21 " 8 "
	1	½- "	20 " 6 "

MONORAIL CRANES			JIB CRANES
Location	Capacity	Operated by	Capacity
Bldg. A	1—2000-lb.	Motor	1—2000-lb.
	4—1000- "	Hand	9—1000- "
Bldg. B	1—2000- "	Hand	4—1000- "
Bldg. F	2—1000- "	Air	10—2000- "
	1—1000- "	Hand	1—1000- "
Bldg. I	1—2000- "	Air	
	1—1000- "	Air	
	1— 500- "	Air	
	5—1000- "	Hand	
Bldg. O-2	1—1000- "	Air	
Bldg. P	1—1000- "	Motor	

On some of the winding machines for the smaller transformers, group drive has been found superior and less costly than individual drive, but on these the shafting system is mounted on the floor directly back of machines, and is driven by motors adapted to the load. Individual machines are thrown on and off by belt shifters.

Testing departments have been equipped with up-to-date apparatus for testing each and every transformer produced.[1]

Products and materials handled vary from small parts and quantities to large transformers weighing around 75 tons. Table 1 shows the location, capacity and general data on the various cranes throughout the plant. Two large freight elevators have been installed in Building I, which is four stories high and one in Building C.

Electric lift trucks have been adopted as the standard handling equipment for transportation within buildings at points not served by cranes and hoists, and between different buildings. These trucks have ample capacity for all such needs, are quiet, quick and convenient in operation, do not injure plant floors, turn on small radii and around sharp corners with-

[1] These will form the subject of a special article to be published in the November issue.

out difficulty and have proved thoroughly reliable and adaptable for every kind of service within the plant. Altogether, nine are in constant use.

The distances which materials are moved by trucks are comparatively long, because straight-line production methods have cut out almost all local handling throughout the plant. The use of hand trucks of any sort has therefore studiously been cut down. Only within storerooms, where aisles are narrow and it is not desirable to have electric trucks operate, and at a few points which electric trucks would have to go far out of their way to reach, are hand trucks permitted. These are all of the non-lift type. Some are of the kind used around freight stations and others are specially made of wood to serve individual needs. At certain machines a type of truck more in the nature

FIG. 3 DIPPING PROCESS FOR PAINTING TRANSFORMER TANKS
Note excellent lighting of shops.

of a movable rack is employed to hold work and carry it to the next operation. These are made at the plant.

At three places within the plant conveyor systems have been found profitable: To carry assembled boxes for smaller transformers from the carpenter shop up one story, overhead, and then down into the shipping department; to carry boxed transformers from the shipping department to freight cars; and on the assembly line for small-size transformers. The lift section of the system in the carpenter shop is of ordinary bar type. The remainder of this section and also the shipping conveyor are of gravity type. The transformer assembly conveyor is of the horizontal roller type and is power driven.

Beside fire doors, sprinkler systems and fire hose, extensive use is made of wagon and hand types of extinguishers, as part of the plant's protective apparatus. A special study along this line has just been completed, and seven units of wagon equipment have been purchased for installation at points where different floors must be reached, or where it is not convenient to locate a fire hose.

For the protection of the plant at times when the working force is absent, such as nights, Sundays and holidays, a complete watchmen's system has been installed, and hourly rounds are made by the men.

Drinking fountains are distributed throughout all parts of the plant at points most convenient to the workers in each section. Wash rooms and toilets are provided for each department and are partitioned off by steel panels reaching from floor to ceiling. Wash sinks are of the multiple type, double-sided, each furnishing room for eight persons. Compound faucets for mixing hot and cold water are provided. Water is heated in tanks in each building by means of exhaust steam in winter and gas in summer.

Toilets are of sanitary porcelain type. Partitions are of steel, raised about 12 in. from the floor. Eighteen inch urinals at 24 in. centers have been provided, thereby saving expense but furnishing ample clearance.

Factory furniture consists mainly of storeroom shelving and racks, steel lockers for the storage of departmental supplies, steel lockers for workmen's clothing in the individual departments, and benches and stools. The benches are mounted on pressed steel legs. The tops are of maple. Where they undergo hard service they are covered with a layer of sheet metal, the thickness varying from $\frac{1}{16}$ to $\frac{1}{4}$ in. Factory stools have steel angle legs and wood seats.

Telephone communication is provided for by 35 outside connected phones and a private interworks system which is quick and convenient in operation. Radio communication is maintained with other Westinghouse works.

The plant has very low accident rate because special care is taken to prevent injuries to employees. All aisles are safeguarded by means of white strips painted down each side. All objects must be kept out of such aisles to permit the free passage of electric trucks and of persons. Around machinery where accidents are likely to occur, guards have been placed, consisting of expanded metal mounted on steel angle frames.

The plant has a complete hospital in which are located offices for the medical staff, a sterilizing and instrument room, and a separate waiting room and hospital room for men and for women. The hospital rooms are equipped with beds for emergency cases and for patients who may later be removed to the city hospital. Complete first-aid cabinets have been installed. Two nurses are in constant attendance and a doctor has a regular schedule of visiting the plant for medical and surgical treatments. He is constantly on call to attend at once to severe injuries.

The proximity of good restaurants and the nearness of the plant to some of the workmen's homes make a plant cafeteria unnecessary. Recreation facilities within the city likewise eliminate the need for special provisions for this purpose by the management, although clubs and athletics are encouraged.

All plans for the new structures, Building H 1075 ft. long, 144 ft. wide and 86 ft. high; Building I four stories in height, 88 ft. wide and 352 ft. long; and necessary extensions to existing buildings, power house, and carpenter shop were prepared by Bernard H. Prack, consulting engineer and architect, of Pittsburgh. All excavation, construction work, and the erection of the new buildings complete was done by the Stone & Webster Company of New York City.

TABLE 2. SUMMARY OF DATA ON WESTINGHOUSE TRANSFORMER PLANT

Location	Sharon, Pa.
Construction	Steel and brick, fireproof, with stone trim. Building I has reinforced concrete framework.
Grounds	Lawn in front. Rest of property devoted to industrial purposes.
Property	42 acres. Length, 3750 ft. Width, 500 ft.
Fence	Steel wire fence encloses plant.
Buildings, size	See Fig. 2.
Floor area:	
New buildings	387,525 sq. ft.
Entire plant	711,000 sq. ft.
Architecture (type)	Industrial, adapted to the particular conditions.
Neighborhood	Industrial, 15 min. walk from business section.
Employees	Now 2500, ultimately 3500 in present buildings. Mostly men in manufacturing departments. Girls employed in winding room and office.
Transportation facilities	Sidings from Pennsylvania and Erie Railroads.
Entrances	Building entrances located to suit production and transportation requirements. Plant entrances placed to suit railroad sidings and for convenience of employees. See Fig. 2.
Windows	Steel sash.
Glass	14 x 20 in. panes, ¼ factory ribbed in plant, transparent in office. Wire-inserted where fire exposure exists. Pressed glass used for interior door and partition panels.
Doors, exterior	At 19 large entrances, electrically operated rolling steel doors. Other doors are wood, with glass panels.
Doors, interior	Tin clad, with wood core, between manufacturing departments and at exits to stairways, carried on trolleys, hangers and track, and equipped with fusible links. Elevator doors, vertical opening type, split horizontally at the middle. Doors in main office, between main office and shop, for shop offices and for toilets are hollow metal, with pressed glass panels in the upper portion.
Roof	Gypsum slab, poured in place. Ridge type. Skylight windows flush with roof extending from ridge partially down each slope. Steel trusses.
Ventilation	Continuous, power and hand type operators for side wall upper window sections. Hand-operated sash for lower sections. Roof ventilators at 100 ft. centers. Special ventilators in carpenter shop and incutting department, Building I.
Walls	Brick. Gray strip, with narrow black border, extending 4 ft. above floor. Above this walls are painted white.
Floors, office	Concrete, covered with ¼ in. battleship linoleum.
Floors, shop	Many of the floors are of concrete construction with a finished coat of coppertone or marble dust. 25% are covered with wood block set on edge, where abrasion on the surface is not excessive and where quietness is essential. In the H-building, where the floor is subject to excessive abrasion, a hard brick covering is laid over a slab of 9 in. concrete, with a ½ in. cushion of 1 to 3 cement and sand between. Concrete floors in test pits and Building F.
Ceilings	Concrete, painted white. Roof trusses and under side of roof slabs also white.
Partitions	The office, as a whole, is equipped with 7-ft. high steel partitions. Permanent partitions throughout the shop, and around all elevators, stairways and places where fire would be hazardous, are almost entirely 9 in. brick. Shop offices have some partitions bought outside and some steel partitions of Westinghouse design and execution. Tool rooms and storeroom partitions are of Westinghouse design and are 7 ft. 6 in. high—wainscoting of corrugated sheet iron 3 ft. high and expanded metal above. Toilets have steel partitions or 4 in. tile, plastered on each side. Between the main office and the shop is a 4 in. tile partition for sound-deadening purposes. Steel partitions in main office and around certain shop departments have upper panels equipped with pressed glass.
Stairs	Steel and concrete, with steel safety treads, in Building I. Pipe rails and concrete landings. Stairs leading to balconies and pits are all steel with safety treads and pipe railing.
Lighting	Direct system, with ceiling lights. 110-volt current, outside power. Shades throughout shop are Sol-Lux reflectors, with lamps ranging from 100 to 1000 watts each and located so as to cast a light of 6 to 10 ft. candles. Lights are placed on approximate centers of from 20 to 25 ft. In the offices Sol-Lux reflectors containing lamps of 150 watts and spaced approximately on 10 ft. centers are used.
Heating	Steam generated at 160 lb. pressure and reduced in the power house so that radiator pressure varies at from 5 to 10 lb. Localized steam coil system employed in shops in units of 1600 sq. ft. radiation each, down the centers of the departments. Over these coils, which are enclosed in casings, fans circulate the air and distribute it through ducts. Heat controlled by manipulating valves to maintain temperature of 65 deg. Wall type radiators used in main office, shop offices, toilets, stairways, etc. Vacuum system on return lines at power house.
Heating line regulator	10-in. reducing valve, 160 lb. to 5 lb.
Boilers (new)	Two 600 hp. water tube boilers generate steam for processing and heating.
Stokers	Underfeed type.
Stoker drive	4¼ in. by 4 in. engines.
Feed water pumps	Two 75 gal. per min. 405 ft. head centrifugals.
Boiler feed regulator	Automatic regulating valve.
Forced draft	Fans used to supplement stack draft.
Water purification	Chemical treatment.
Feed water heater	Open type.
Boiler instruments	Flow meter, draft gages, pressure gage.
Stacks	Two, of tile. New one is 205 ft. high, 9 ft. inside diameter at top. Old one is 150 ft. high, 7 ft. inside diameter at top.
Pipe covering	85 per cent magnesia, for heating mains.
Coal handling	Track hopper, crusher, bucket elevators, screw conveyor, 400 ton capacity steel bunker, traveling weigh larry and chutes.
Ash handling	Ash hoppers and ash gates under stokers. Industrial car and track in basement carry ashes to skip hoist which delivers to storage bunker over outside railroad track.
Power facilities	12,000 kva. sub-station consisting of three 4000 kva. transformers, single phase, 60-cycle, high voltage 66000. Testing equipment consists of an 800,000 volt unit (largest commercial tester in existence) and a 500,000 volt unit.
Local power units	Three 300 kva. capacity motor-generator sets, for crane power. A 1500 kw. turbo-generator also run during winter.
Compressed air	Two-stage air compressor, steam-driven, size, high pressure, 16 by 20 in., low pressure, 26 by 20 in., is run during the winter. In summer, an air compressor, size 13 by 16 in., driven by a 265 hp. synchronous type motor is operated. Line pressure 85 lb.
Artesian well pump	Duplex deep well pump, 50 gal. per min. capacity.
Water system	Pumping station on Shenango River delivers water to power house well. One 2000 gal. and two 1000 gal. centrifugal pumps carry it to an overhead steel storage tank of 150,000 gal. capacity, for gravity feed. Centrifugal pumps are controlled by a regulating valve. This water is used for boiler feed, industrial purposes and fire protection. High buildings have a booster pump on first floor. City water is connected for instant reserve service.
Fire pumps	One 18 by 10 by 20 in., 1000 gal. per min. pump and one 16 by 9 by 12 in., 800 gal. per min. pump connected to sprinkler system and to hose lines. Both are duplex reciprocating type pumps.
Motors	Direct drive used except for groups of winders in original buildings. A. C. motors installed, suited to each individual case.
Chain drive	Used at short centers and to secure quiet, non-slip running.
Cranes and hoists	See Table 1.
Electric trucks	Nine of these handle all long-distance transportation. A battery-charging outfit employed.
Hand trucks	Made at the plant. Special constructions. Used only in storerooms and to transfer materials between adjacent machine processes.
Elevators	Two 8000-lb. capacity elevators in Building I, and one 6000-lb. in Building C.
Conveyor systems	Bar-lift and gravity conveyor in carpenter shop, gravity conveyor in shipping room, horizontal roller conveyor in small transformer assembly room.
Hand hoists	Employed at individual machines.
Locomotive cranes	One 15 ton capacity, 50 ft. boom.
Dust and fume collectors	Pneumatic systems in carpenter shop, cutting department and Building A. Over solder and acid pots sheet steel hoods are placed and fumes are carried off by fans.
Sprinklers	Entire plant equipped with system.
Fire extinguishers, Wagon type	Seven 40-gal. extinguishers installed at points of special danger, such as carpenter shop, impregnating room, and on each floor of Building I.
Hand type	Installed at various points throughout plant.
Fire hose	Complete system in important locations. Underwriters approved type.
Fire alarms	1 city box, 33 interworks alarm boxes.
Watchmen's system	System installed.
Storage shelving	Light pressed steel shelving. Painted dark green.
Storage racks	Made of structural steel. Built at plant.
Factory benches	Pressed steel legs; maple tops, in some cases covered with 1/16 to ¼ in. sheet metal to prevent wear. Built at plant.
Factory stools	Steel legs, wood seats.
Blinds	Used in office only. Venetian type.
Drying kilns	Four large ovens, equipped with temperature recorders.
Safeguards	Aisles painted weekly with white strips along each side, to guide traffic. Machines have guards of expanded metal on steel frames, made at plant.
Hot water heaters	Heated by exhaust steam in winter and gas heaters in summer.
Wash bowls	Porcelain. Multiple type, with room for 8 persons.
Closets	Porcelain.
Urinals	Porcelain, 18 in. width on 24 in. centers, with special concrete platforms.
Toilet partitions	Steel, 12 in. clearance from floor, between closets.
Drinking fountains	Wall type, white porcelain, spaced at about 125 ft. centers throughout the shops.
Plant communication	Thirty-five outside connected phones and about 200 interworks phones throughout shop and office. Also a radio broadcasting and receiving station to communicate with other Westinghouse works.
Time system	Time recording clocks for in and out records. One master clock and 35 secondary clocks in the various departments.
Hospital equipment	Metal type. Sanitary construction. Four iron beds, 2 operating tables, with chairs, cabinets, etc. Complete sterilizer.
First aid equipment	Metal cabinets, with complete equipment.
Rest rooms	Two large, well-lighted rooms provided for girls who work in the shops.

Do Branch Plants Pay?

Two Manufacturers Analyze The Problem and Find Different Answers

By A. G. ANDERSON

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DOES it profit most to manufacture in one big plant, or to operate branch factories strategically located? Which arrangement will assemble raw materials, convert them into finished goods and put them into the hands of customers at the least total cost?

For many years the tendency was to concentrate production, and there are many obvious advantages of so doing. But during the past several years there has been a marked swing in the opposite direction, for definite and sound economic reasons. Among these factors are: (1) The troublesome labor situation in industrial centers, (2) increased labor costs, (3) greater cost of transporting both raw materials and finished goods, (4) growing sales volumes in particular territories, and (5) additions to lines of products manufactured. Yet concerns operating two or more plants may well question whether the advantages enjoyed will offset the gains possible by increased production under one roof. Will plant consolidation pay? Will decentralization yield more profits? Executives should hesitate to take a step in either direction without a careful analysis of their own organization and the industry of which they are a part, both as to the present situation and future probabilities.

The writer has recently studied the general problem of plant location and presents the gist of two reports covering specific plants; one suggests the consolidation of two plants, the other the continuation of an established branch plant.[1]

The First Report

The first report deals with the desirability, from a physical and cost basis, of consolidating an Indiana plant with a Wisconsin plant producing heavy construction machinery. These will be referred to as the I plant and W plant, respectively.

The I plant comprised modern buildings and fairly good equipment covering a working area of 261,790 sq. ft., with a total site area of about 50 acres. It was valued at about $925,000. Three sizes of one type of machinery were produced. The work approached a quantity production as the machines were made in orders of from 10 to 20 at a time. This quantity was not sufficient, however, to take them entirely out of the jobbing class, but did permit special tooling for practically all parts. In the machine shop the work was divided for weights of parts and class of machine work. The heavier-parts machines were arranged for the general sequence of operations, while the lighter-parts machines were classified into groups such as small, medium or large lathes, turret lathes, screw machines, drills, etc.

The W plant occupied a site of about 40 acres with working area totaling 835,960 sq. ft. The buildings were fairly modern in most respects, with some old structures; the equipment was in good condition. Book figures for the plant indicated a value of about $2,000,000. Large-sized units of construction machinery of several different types was produced, the work being handled on a jobbing basis.

The production in the two plants was similar, the difference being in the nature of the finished product. The detail parts are similar in design and manufacture. This similarity made it advisable from a production standpoint to consolidate the two plants.

Plant Consolidation

The transfer of the I plant production to the W plant was carried out by the expansion of the various departments in the W plant to accommodate the production of similar I plant departments. The differences in class of work in the structural shops are an advantage. Small and medium-sized work are increased sufficiently to permit dividing them and using one bay for each, medium in one side, heavy in the center and light in the other side bay.

Each plant required a complete, well equipped tool and maintenance shop which, when consolidated, has been reduced. Fifty per cent of the equipment for these departments of plant I when moved to plant W makes a well balanced and flexible shop capable of handling the work with greater efficiency and a reduced personnel. The tool stores, when centralized, eliminate the duplicate stocks of expensive drills, reamers, etc., which means a reduced inventory. The employees' locker room clears the shop floor of the scattered lockers and in so doing removes one point of previous inefficiency. The structural stores of plant W were largely duplicated for plant I so that a consolidation adds but little to the present W stores. The consolidation of the machine shops permits the arrangement of machines for class of work. The saving in working area from the combination was 80,620 sq. ft.

[1] From the work of Frank D. Chase, Inc., Engineers and Architects, Chicago.

One combined organization is able to function with fewer employees, especially the supervisory and clerical, than two that are entirely separate but similar.

The production of the working force in the forge and heat treating departments is increased by a better layout, with more than one furnace per hammer. The number of men in the machine and erection shops was not affected, but the classification of work and use of special tools permits a more specialized supervision and inspection.

The increase in stores received and carried does not require a proportionate increase in labor. Consolidation decreases the yard labor as extra handling of castings is eliminated, structural steel is handled more direct from cars to storage, and bar stock, pipe, etc., are handled more efficiently in larger lots. Working forces are kept uniformly busy. The transportation about the plant is improved by the more efficient layout and improved facilities. One half the shipping clerks and men of plant I were added to the force at plant W. No additional supervision is required. The additional work, which results in a more uniform demand, makes the working force more efficient. The increase in the power plant facilities does not increase the force of the present plant W.

TABLE 1. CAPITAL EXPENDITURES, FIXED ASSETS AND OPERATING EXPENSES OF THE CONSOLIDATED PLANTS

Capital Expenditure:			
New Construction:			
Carpenter Shop		$ 8,300.00	
Forge Shop		14,100.00	
Structural Shop		85,200.00	
Service Building, 3d Floor		30,000.00	
Garage and Stable		14,000.00	
Machine and Erecting Shops		286,000.00	
Fencing North Site		2,200.00	
Stores and Shipping No. 19		45,900.00	
Switch Track North Site		4,000.00	
Fuel Oil Storage (new)		2,000.00	
			$ 491,700.00
Equipment:			
Power Plant and Lines		$ 118,000.00	
Shop Cranes		40,100.00	
Special Car		1,000.00	
			159,100.00
			$ 650,800.00
Deferred Charges:			
Wrecked Buildings		$ 23,375.00	
Structural Crane Yard Moved		6,400.00	
Switch Tracks Moved		4,500.00	
Track Scale Moved		1,000.00	
Test Weights Moved		1,000.00	
Fuel Oil Storage Moved		5,000.00	
Equipment—Forge	$4,750.00		
Machine	3,000.00		
Structural	300.00		
From Plant I	15,000.00	23,050.00	
Loss on Plant I		350,000.00	
			$ 414,325.00
Fixed Assets:			
Land		$ 111,000.00	
Building and Improvements:			
Rehabilitated	$846,275.00		
Wrecked	23,375.00		
	$822,900.00		
New Construction	491,700.00	1,314,600.00	
Machinery and Equipment:			
Rehabilitated	$1,132,800.00		
New	159,100.00		
From Plant I	190,000.00	1,481,900.00	
Drawings and Patterns:			
Machinery	$ 124,100.00		
Equipment	65,000.00	189,100.00	
Total			$3,096,600.00
Operating Expenses per Year:			
Taxes, 25 mills on 55 7% valuation:			
Inventory—98% Machinery and Equipment		$2,532,830.00	35,270.00
Building and Machinery		2,796,500.00	38,940.00
Drawings and Patterns		189,100.00	2,635.00
Insurance $0.10 per $100 per year on 85%			
Inventory, Buildings, Machinery, Drawings, etc.		5,518,845.00	4,690.00
Depreciation:			
Buildings, Machinery 3% even		2,796,500.00	83,895.00
Drawings, Patterns, 20% balance		189,100.00	37,820.00
Maintenance:			
Buildings, Machinery		2,796,500.00	
Tools			255,000.00
Power Plant—Fuel and Water			166,000.00
Interest—Capital Inventory		650,800.00	
Sale of Plant I		319,785.00	
6% on net		$ 331,015.00	19,860.00
Total			$ 644,110.00

Net Saving in Payroll and Insurance on 84 employees.

Deferred Charges, $414,325.

TABLE 2. COMPARATIVE FREIGHT RATES ON FINISHED PRODUCT INTO MARKET AREAS

EAST DIVISION

Rate To	From Plant No. 1		From Plant No. 2	
	C. L.	L. C. L.	C. L.	L. C. L.
New York	1.215	1.390	1.145	1.305
Pittsburgh	1.020	1.195	0.820	0.965
Detroit	0.800	0.935	0.585	0.690
Indianapolis	0.890	1.040	0.700	0.825
Totals	3.925	4.560	3.250	3.785
Total Average	4.243		3.517	
Net Average	1.061		0.879	

WEST DIVISION

Rate To	From Plant No. 1		From Plant No. 2	
	C. L.	L. C. L.	C. L.	L. C. L.
Chicago	0.550	0.615	0.635	0.745
San Francisco	3.675	4.430	4.550	5.250
Dallas, Texas	1.545	2.370	2.435	2.845
Totals	5.770	7.415	7.620	8.840
Total Average	6.592		8.23	
Net Average	2.197		2.743	

TABLE 3. PERCENTAGE OF SHIPMENT TO EAST AND WEST

Shipments East		63%
Shipments West		37%
Rate Factor for Plant No. 1:		
East—63% x 1.061	66.843	
West—37% x 2.197	81.289	
Total		148.132—100%
Rate Factor for Plant No. 2:		
East—63% x 0.879	55.377	
West—37% x 2.743	101.491	
Total		156.868—106%
Difference		8.736— 6%

Fewer men are required for the tool rooms. Building maintenance is reduced by the erection of new and more compact buildings. The electrical force is reduced by consolidation and there is a decrease in the total demand for repairs due to less total equipment. The tool and machine repairs will be relieved to some extent and permit of a smaller total force. The combined departments have a sufficient amount of each kind of work so that it can be done more economically.

The general office force is not affected. The works

and engineering forces of plant I were entirely eliminated. The production organization of plant W is increased by 50 per cent of the plant I force. The purchasing and stores record forces of plant I were practically eliminated, a slight increase in the plant W stores record force being necessary to handle the additional work.

A consolidated financial statement covering fixed assets, capital expenditures, deferred charges and operating expenses is given in Table 1.

Comparing the consolidation with the old plants I and W shows an increase of fixed assets from $2,849,885 to $3,096,600, or 8.5 per cent at a capital expenditure of $975,500 and deferred charges of $477,100. The capital expenditure is offset in part by an estimated sale value for plant I of $319,785. Operating expenses are increased from $636,375 to $644,110 or about 1.2 per cent, which is more than offset by the saving in payroll and insurance on 101 employees, including high-priced supervisory forces. Under the existing conditions, operating expenses should normally decrease, and the fact that in this case they do not draws attention to the high tax rates effective in Wisconsin. Due

TABLE 4. PROCESS MATERIALS REQUIRED ANNUALLY

Lumber	$273,163.35	
Veneer	84,408.25	
Glue	17,065.72	
Finishing Material	20,811.85	
Upholstery Material	3.633.92	
Hardware and Supplies Direct	10,720.18	
Total		$409,803.31
F. P. & W. I. P. Purchases		2,611.66
Hardware and Supplies Expense		18,289.07
Fuel—2408 Tons Coal		15,088.04
Total		$445,792.08

to the consolidation, taxation charges are increased by 29 per cent, and the increase of $17,140 in this item more than offsets gains in other items of $9405. The amount of inventory has been reduced 2 per cent for stock common to both plants. Maintenance including payroll has been reduced 5.5 per cent, largely due to new buildings in place of old and elimination of upkeep on plant I.

The direct savings in annual operating expenses and payroll is about $113,000. At this rate it will take four or five years to pay off deferred charges, or 10 years for both deferred charges and net capital expenditure, after which the savings will amount to $153,000. Thus the benefits accruing from the consolidation are substantial.

The Second Report

The second report deals with the two plants of a furniture manufacturer, located in different middle-western states, each producing a highly specialized product, but similar from a production standpoint. Confronted by the need for a considerable immediate expenditure in rehabilitation work, it was desirable to map out a definite program for the ultimate development of the business in order that all improvements made might fit into the final scheme. To this end, a study was made to determine the feasibility of combining plant no. 1 successfully with plant no. 2.

A study of the distribution showed that the product covered the entire country, and for purposes of analysis the territory was divided into two areas, an east and a west division. The product of plant no. 1 which it was desired, if profitable, to manufacture at plant no. 2 will be designated as A. The geographical advantages so far as freight on the finished product was concerned may be indicated by a comparison of freight rates to the localities of principal consumption. In

TABLE 5. FREIGHT ON LUMBER AND VENEER

Rate per Cwt.	To Plant No. 1	To Plant No. 2	Diff.
Lumber from Memphis	$0.29	$0.23	$0.06
Veneer from Louisville	0.36	0.34	0.02

Average difference, favor of Plant No. 2	$ 0.04
1924 amount of lumber and veneer	14,688,000 lb.
Saving in freight to Plant No. 2 —$0.04 per cwt.	$5,875

Table 2 the rates from both plants are given for carload and less than carload shipments, with the difference in favor of either plant no. 1 or plant no. 2.

To establish an assumed difference in freight advantage for either plant location, the percentage of shipments to east and west divisions were used, based on factory cost values. (See Table 3.)

From these calculations it is reasonable to estimate that the freight on finished product will be 6 per cent greater from plant no. 2 than from plant no. 1, giving the latter a proportionate geographical preference. On $50,000, the amount of freight charges on finished products the past year, this extra amounts to $3000.

Table 4 indicates the raw materials required for production annually. Lumber and veneer are the principal ones. The freight on all other materials may be assumed to be unchanged by plant location. A marked difference is obtained on lumber and veneer. (See Table 5.)

The inventory of lumber and veneer may be reduced at plant no. 2 as this locality is a better market than

TABLE 6. FINANCIAL ANALYSIS OF LABOR TURNOVER

Total Exits at Plant No. 1	197 men
19% Reduction, 37 men—leaves	160 "
40% vs. 85% Turnover, or 47% Net Reduction, 75 men leaves	85 "
Total Reduction	112 "
112 Men at $150 Each	$ 16,800 saving

at plant no. 1. The handling charges on materials, especially lumber, are lowered by consolidation.

Both plants are operated on a 50-hr. open shop basis, and a similar class of labor is employed for the ordinary wood-working departments, but the product of plant no. 1 requires high-class workmen. These are readily available at plant no. 2, but not at plant no. 1 owing to limited opportunities for employment.

The cost to the company for turnover is an intangible item affecting the labor hours or payroll, material account or scrap, maintenance of equipment or repairs, and efficiency of the plant as a whole. It is reasonable to figure the cost at an average of $150 per employee

leaving the company's employ or classed as an exit. The exits at plant no. 1 are 197 per year. A consolidation with plant no. 2 will reduce this, (1) because of 19 per cent fewer workmen needed, and (2) by the proportion of 40 to 85 per cent turnover rates at the

TABLE 7. COMPARISON OF WAGE RATES BY DEPARTMENTS

Department	Rates at Plant No. 1			Rates at Plant No. 2		
	Max.	Min.	Avg.	Max.	Min.	Avg.
Mill and Machine	0.606	0.397	0.501	0.80	0.41	0.660
Glue and Veneer	0.56	0.458	0.509	0.82	0.75	0.785
Cabinet	0.738	0.35	0.544	0.97	0.71	0.880
Finishing	0.631	0.40	0.515	0.71	0.55	0.630
Carving	1.175	1.036	1.105	.....	.....	.....
Packing and Shipping	0.72	0.45	0.585	0.66	0.45	0.555
Yard	0.733	0.495	0.614	.....	.....	.....
Elevator and Watchman	.....	.....	0.387	0.45	0.42	0.435
Stock Keeper and Inspector	0.708	0.45	0.579	0.75	0.45	0.600
Millwright	.....	.....	0.483	0.70	0.45	0.575

two plants. The effect on costs is shown in Table 6.

The average wages paid per hour in the two plants are compared by departments in Table 7 and range between maximum and minimum according to skill and class of workmen:

Class no. 1—Exceptional skill in making product A
Class no. 2—Ordinary skill
Class no. 3—Helpers
Class no. 4—Laborers

The distribution of employees and payroll for 1924 by departments at plant no. 1 is used as a basis for estimating the requirements at plant no. 2 for the

TABLE 8. COMPARISON OF LABOR COSTS FOR PRODUCT A

Department	Plant No. 1		Reduce Force	Add Rate	New Payroll Plant No. 2
	Men	Amount			
Managers and Office	8	$36,463.39	50%	.....	$12,350.00
Mill and Machine	50	73,106.67	33%	32%	64,700.00
Glue and Veneer	16	25,225.21	25%	54%	18,900.00
Cabinet	65	96,520.89	.....	62%	156,600.00
Carving	11	27,944.76	.....	.....	27,845.00
Finish and Upholstery	9	67,648.64	.....	22%	82,400.00
Packing and Shipping	14	18,042.66	50%	5%	8,560.00
Lumber and Yard	9	10,252.38	50%	12%	5,750.00
Engineer and Fireman	2	8,408.64	100%	.....	.....
Elevator and Watchman	2	3,066.11	.....	12%	3,435.00
Stable	2	519.92	100%	.....	.....
Stock and Inspectors	5	11,145.23	.....	4%	11,600.00
Millwright	3	4,907.62	67%	19%	1,310.00
Totals	231	$373,152.12	19%	30%	$394,350.00
Net Increase at Plant No. 2, 6%					$21,200.00

production of product A. Included in this list is an estimated reduction in personnel or payroll that may be expected if the plants are consolidated. This reduction is accounted for by combining certain departments, eliminating payroll for others, and general increased efficiency and production capacity due to closer supervision by the engineering department and improved methods as well as incentive to workmen in the way of premium payments. At plant no. 2 the improved personnel conditions due to the welfare organization is evident, a feature possible because of the larger size of the plant. Table 8 shows the anticipated net payroll for producing product A at plant no. 2, and indicates an increase of 6 per cent, or $21,200 a year.

The occupancy of plant no. 1 is listed by departmental areas and the areas that would be deducted in figuring space for this plant's production at plant no. 2 are shown in Table 9. The economy of space effected is thus made clear.

In considering the development of plant no. 1 for the immediate future an expenditure of $61,500 was estimated, which gives a basis for consideration of the cost of the necessary additions and improve-

TABLE 9. OCCUPANCY AREAS IN PLANT NO. 1 AND DEDUCTIONS EFFECTED BY CONSOLIDATING PLANTS

Department	Plant No. 1 Sq. Ft.	Deducted Area Sq. Ft.
Dry Kilns	9,000	6,000
Dry Storage	6,200	.....
Mill and Machine	25,000	.....
Cabinet	23,800	.....
Finishing	14,500	.....
Packing and Shipping	12,500	.....
Stores	14,500	.....
Office	1,600	1,600
Power Plant	3,000	3,000
Stable	2,400	2,400
Total	112,400	13,000
Lumber Yard	18,000	.....
Gross	130,400	112,400
Net Total	.....	99,400

ments at plant no. 2 as an alternative plan. These were estimated to amount to $593,700.

The total operating expenses for plant no. 1 considering its development for the immediate future were estimated to be $878,945. To produce this same product at plant no. 2 it was estimated that the operating expenses would amount to $884,929, a net increase of $5984. A comparison of operating expenses is given in Table 10.

TABLE 10. DIFFERENCES IN OPERATING EXPENSES

	Plant No. 1	Plant No. 2
Tax Rate per $100:		
Blanket Rate	2.195	.....
City and School	.....	2.226
State and County	.....	0.368
Amount Assessed:		
Real Estate and Buildings	$121,650	.....
Personal Property	61,300	.....
Foreign Corporation:		
Present Amount	.....	$2,613
Increase (estimated)	.....	390
Fire Insurance:		
Rate on 90% Value	0.532	0.20
Amount Carried	$500.000	.....
Accident Insurance:		
Rates—Factory	1.548	0.86
Office	0.05	0.03
Amount Carried—Factory	$365,100	$382,000
Office	27,600	12,350
Use and Occupancy Insurance:		
Rate	0.53	0.242
Amount Carried	$250,000	.....
Boiler Insurance, same at both plants.		

It is apparent from the foregoing data that to consolidate the two plants it would be necessary to make a capital investment of $593,700 at plant no. 2. To justify this it would be necessary to show a saving in operating costs of at least 6 per cent, or $34,700, whereas an increase of $5984 is indicated. Although there are a number of intangible advantages favoring consolidation, the figures hardly warrant the move.

General Electric Transportation

Methods and Equipment Used to Handle a Vast Annual Tonnage at the Schenectady Works

By GUY BARTLETT

General Electric Company, Schenectady, New York

A FREIGHT terminal large enough to care for the needs of a city of a quarter-million population—with 25 locomotives, 1350 cars, and more than 50 miles of track—is included in the transportation facilities of the Schenectady works of the General Electric Company.

With this equipment, 14,783 standard gage cars were brought into the yards in 1924, and 11,569 were sent out. On the narrow gage, or industrial, railway, 275,826 cars were used to handle the internal movement of material in the works. The average daily handling amounted to 907 cars. Records show that 446,905 tons of raw materials were received, and 127,541 tons of finished products sent out.

FIG. 1 DIFFERENT TYPES OF TRANSPORTATION EQUIPMENT USED

Transportation in the Schenectady works comes directly under the supervision of the general superintendent. The New York Central and Delaware and Hudson railroads deliver three or four trains of loaded cars to the plant daily. The material is received through the receiving department, and from there is delivered to the various departments of the plant by narrow gage and standard gage cars and by motor trucks. Finished products are sent out of the plant through the shipping department, and delivered by the connecting railways to proper destinations, both domestic and foreign. (See Fig. 1.)

Seven electric locomotives, 350 cars, and 25 miles of track take care of the requirements of the standard gage system. Box cars and flat cars, dump cars, special low flats, and cars of special design for transporting giant turbine parts—such are among the types which are always ready for service. The locomotives are operated both night and day in and about the plant. (See Fig. 2.)

Facilities for handling freight economically include 23 unloading stations and 20 loading stations, equipped with all modern appliances, such as crane service and electric trucks. The new locomotives are so constructed that they can be fed from an overhead trolley or can operate on non-electrified lines by drawing their power from storage batteries.

Building 50 is the freight terminal. Within this structure and beside it are standard gage tracks. Finished products are brought into the building on the narrow gage tracks and by motor trucks, and are carried to the loading platforms on narrow gage flats. There they are picked up by a traveling gantry crane and carried to the proper car for loading. Empty narrow gage cars are removed as shown in Fig. 3.

Direct Routing of Materials

It is, of course, preferable that material, especially larger units, be sent out direct from the building in which the work is completed. A large amount of the incoming material is also intended for definite buildings. The standard gage system therefore includes a network connecting strategic buildings throughout the works. Adjoining the New York Central and Delaware and Hudson tracks there are the General Electric yards, from which the branch lines are fed. The main artery of the standard gage system is along the east boundary of the plant, so that the tracks are kept off the main Works Avenue.

Eighteen locomotives, more than 1000 cars, and 28 miles of track are needed to care for the requirements of the narrow gage system. This system is used for delivering heavy materials and apparatus from one department to another, and is subject to call from 154 locations throughout the works. Cars and trains

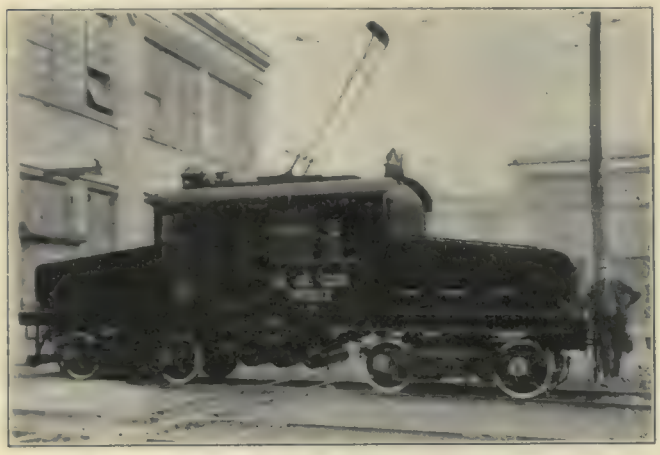


FIG. 2 STANDARD GAGE ELECTRIC LOCOMOTIVE

run on regular schedules, buildings are visited at definite intervals, and the outgoing freight movement coincides with the schedule of the main line roads so that little delay occurs in getting shipments on their way.

Practically all buildings have narrow gage service. In Works Avenue, the main artery of the plant, there are double tracks for most of the length, and triple tracks in one section. Branches throughout the entire length extend to the different buildings. Within the buildings, these industrial tracks may be further branched and carried to upper floors by elevators.

This narrow gage road is a miniature division, self-contained, and with its own maintenance and repair departments. Like all railroads, it has its problems. One is the movement of giant castings and forgings, many tons in weight. To meet such demands, narrow gage cars of 100 tons capacity have been built. (See Fig. 4.) The bow type trolley, which automatically reverses, and the different special cars are all products of the maintenance department.

Experimental tracks were laid within the Schenectady works in 1902. The worth of the industrial railway system was at once apparent, and constant additions of track and equipment have been made since then. It is not alone in the Schenectady plant that the company has found the solution of its internal transportation problems in the use of the industrial railway system—the Erie, Pittsfield, Lynn and other works are likewise served.

Service of the Industrial Railway

It is interesting to note the many different kinds of service performed by the industrial railway. In some buildings the products are large units, and these are loaded directly on the flat cars for transportation to the next building. In other shops the products are small, and these are transported in boxes of convenient size on the flat cars. The removal of rubbish and waste in elevated drop-side dump cars is another important duty of the railway. (See Fig. 5.)

In most of the work, the demands of the different buildings do not vary much from day to day—they will receive a certain number of loaded cars each day and will have ready for removal a number of reloaded cars. There is, therefore, a certain constant demand upon the railway facilities. At times, however, the railroad is called upon to move machinery, transport special material for special jobs, and perform similar services, in addition to the regular schedules. Thus the work is varied.

Winter Problems

The snow and weather conditions prevailing during the winter months add to the railway problems, making it necessary to have additional equipment. All tracks and switches are kept open by operating sweepers and snow plows, starting when the storm begins and continuing until it ceases. Unless this is done, it is difficult to keep up regular factory production schedules.

The main avenues, side avenues and spaces around buildings are kept open during these storms by using a 10-ton tractor with a snow plow attached. The

FIG. 3 CRANE FLOORING NARROW GAGE CAR

Continuous one-way service is maintained in Building 50 by removing empty narrow gage cars over standard gage track by electric crane.

snow is swept out near the tracks, and the snow loader, beside the tracks, loads it in the cars. Without this equipment, the plant would have been severely handicapped during two of the storms last winter. (See Fig. 6.)

During the storm which started January 29, 13 in. of snow fell, and the exceedingly high winds of the following day caused drifts at different parts of the plant as high as 4 ft. On February 2 another storm left 10 in. of snow. Four trains of eight cars each continually hauled snow from the yard to the banks of an adjacent canal. A total of 1820 carloads was handled in this time by the narrow gage railway. The standard gage hauled 60 carloads, and the auto trucks 300 loads.

Among the advantages of the use of electricity in such transportation work are:

The electric locomotives are stronger, quicker and safer in operation, and they stand up better in winter. Four of the General Electric locomotives, built in 1907, have recently been overhauled. They are practically as good as new, and will handle the same tonnage as a new locomotive. A steam locomotive of the same age would have deteriorated fully 50 per cent unless rebuilt from the ground up.

It is true that overhead wires are perhaps an impossibility in classification yards, but the storage battery feature of the combination locomotive can be employed for such places.

A steam locomotive is generally in service only 45 per cent of the time; the electric is not hard put to keep going 95 per cent of the time.

How could the plant's transportation problems be solved without the railway system? Not even 5000 horses could do the work. The plant would be transformed into a stable, and an army of men would be necessary to care for the horses. Hundreds of wagonloads of food and straw would be required daily, and a corps of veterinary surgeons would be needed.

Motor trucks and tractors might be employed. It is true that this would be simpler, but an army of trucks would be required, and the transportation of large castings would be too much of a problem for serious consideration.

Automobile Truck Service

In addition to the railway system there are employed in transportation work more than 30 auto trucks ranging from ½ to 5 tons in capacity; and 14 electric trucks ranging from ½ to 2 tons. During 1924, 34 of these trucks transported material amounting to 291,873,000 lb., and traveled more than 223,000 miles.

In Building 225, where these trucks are housed, tele-

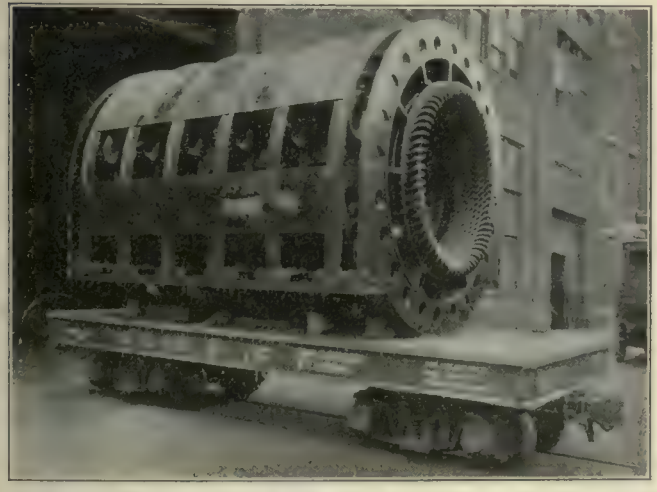


FIG. 4 NARROW GAGE FLAT CAR OF 100 TONS CAPACITY

phone orders received each day average about 75. On some days the total reaches 125. These are in addition to teamsters' orders which are delivered at the garage, or left in boxes fastened on buildings for that purpose. In addition, there are also regular pick-up routes.

When orders are telephoned for a truck, inquiry is made as to how much material is to be transported, and to what destination. This information insures good service; and it means that a 5-ton truck is not sent for a 100-lb. parcel. Material is supposed to be ready for the trucks before the call is made.

The trucks can make deliveries to points not reached by the railroads, and can also handle small orders more advantageously. In winter they have added im-

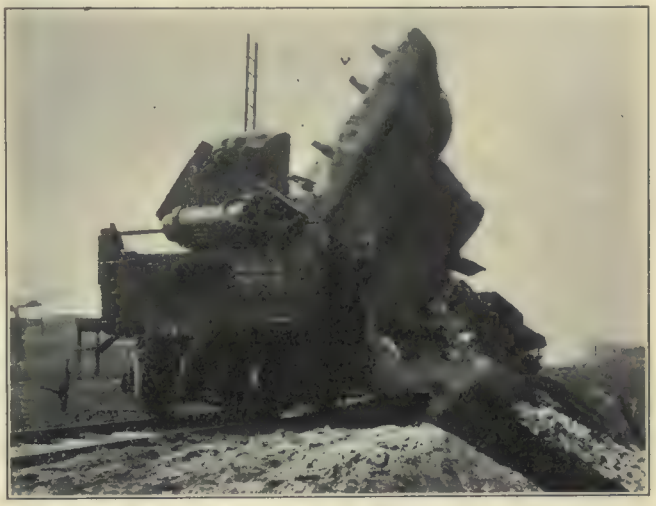


FIG. 5 REFUSE DUMP CAR ON NARROW GAGE SYSTEM

portance. Temporarily, at least, they must take over a portion of the railroad's work, for trucks can operate practically always before the switch tracks are cleared. They are also needed for the removal of snow from Works Avenue, although the electric trains take away most of it along the tracks. Trips into the city of Schenectady must also be cared for by the trucks.

The trucks are called upon from time to time to transport material from the local works to other General Electric plants or to installation jobs. Figures show both speedy delivery and economy in such a procedure.

Cars for which licenses were taken out for 1925 include 12 electrically-driven commercial cars, 34 gasoline-driven commercial cars, 6 electric automobiles, and 32 gasoline automobiles. The automobiles are intended for the use of officials when entertaining guests and customers, and for use within the works.

Other equipment, for the maintenance of which the transportation department is responsible, includes more than 75 industrial trucks of many designs. These smaller units are run by storage batteries, and are kept in the buildings they serve. Some are equipped with cranes, some with low loading platforms, and some are made for service with a number of trailers. Most of them are used within individual buildings.

Electric Truck Service

In the usual schedule under which the trucks make their rounds through the works, one collects large express packages, and another collects small packages.

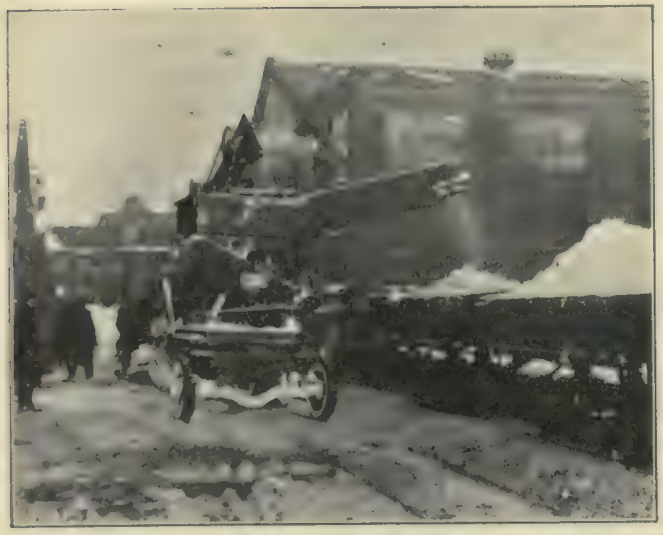


FIG. 6 BARBER-GREENE SNOW LOADER CLEARING YARD IN WINTER

Two are on freight service; two answer the demands on Building 50, the freight terminal; and still others go on regular routes, stopping wherever the swinging arm is raised at a shop door. These trucks both collect and deliver. A dispatcher in a roadster stops at the garage every 15 minutes, collects the special orders, and assigns them to the proper trucks in the course of his four-times-an-hour tour of the plant. Such a procedure eliminates the necessity of the truck drivers repeatedly communicating with the garage.

The fleet of trucks includes not only the usual open and closed trucks, but also dumps and cranes. There is also a passenger bus, which four times an hour makes the journey of more than a mile down Works Avenue. The motorized fire department and ambulance might also be included in the transportation facilities of the works.

The last of the horses are to disappear. Two of the fire department veterans are on the company farm. The other two have been on service with the water sprinkler, but that equipment is now to be motorized.

Maintenance departments are needed not only by the railway and truck department for their apparatus, but for their right-of-ways as well. The rails are rock ballasted, and constantly cared for; and the major roads are paved, and also constantly looked after to keep them in repair.

"Safety first" calls for a maximum speed of eight miles an hour inside the works. Accidents are indeed rare within the company gates, in spite of the large number of trains and company automobiles, as well as the even larger number of automobiles of employees. During the time when the 20,000 or so employees are leaving the works—from 11:55 to 12:10, and 4:25 to 4:40—traffic inside the plant is at a standstill. All automobiles and trucks must be off of Works Avenue, in favor of the pedestrian.

New Developments in Simplified Practice

THE Simplified Practice Division of the Department of Commerce again reports substantial progress in the vast program now under way in American industry.

Estimates made by various groups in the plow bolt and nut industry place the annual savings to that industry through simplified practice at $600,000. The reduction from 1500 to 840 items also means convenience and added savings of time, to manufacturers and distributors and users.

Reduction of styles and sizes of tacks to the extent of 54 per cent, and of packing weights 62 per cent will be recommended by a simplification committee of the tack industry, at a general conference of producers, distributors and users held early in October.

Adoption by a general conference, under the auspices of the Division, of manufacturers, distributors and shipper organizations, of a simplified practice program reducing the variations in thicknesses of box board, is declared by many of the shipper organizations and manufacturers to be a long step forward. Fully $5,000,000 will be saved annually to the industry.

Bolt, nut and rivet manufacturers will save $12,000,000 a year by the substitution of a proposed package or weight count for products, instead of the present decimal count. The methods have already been tried out for carriage bolts of 6 in. and less length, and have saved labor, carton space as high as 33⅓ per cent, space wastage in shipping weight of 20 per cent per case, and much handling on the part of dealers. The change involves adopting approximately five sizes of cartons, each a multiple of its next smaller size, which will be packed full instead of with a definite number of the product contained. A series of 18 sizes for packing cases, to contain anywhere from 12 to 40 cartons, is suggested as sufficient for all shipping requirements. Shipping savings to the consumer will total $700,000 for the entire industry.

The Division, on September 23, held a general conference of manufacturers, distributors and users of grinding wheels. The tentative simplification program calls for the elimination of some 450,000 styles, sizes and shapes of grinding wheels now carried in stock.

The canning industry, as represented at a preliminary conference of can manufacturers, canners, distributors and others held on July 15, has decided in favor of eliminating the many variations within each nominal size. The Division has been asked to make further surveys as to production.

The Associated Knit Underwear Company of America and the Southern Yarn Spinners Association have undertaken to determine what yarn sizes might be eliminated through a simplification program.

The Electrical Manufacturers Council, through its Carbon Section, is taking up with the Division a proposal that sizes of carbon brushes for motors be simplified.

A committee on simplification of packages, of the insecticide and fungicide industry, is now making rapid progress in surveys and analyses.

Making a Success of the Small Manufacturing Business

II. How to Run the Shop

By C. U. CARPENTER

THE point of these articles is: Face the facts! The first[1] took up the product. There are many possible slips in designing the thing you are to sell. With these difficulties out of the way you have arrived at the question of your shop.

To build or lease? I suppose that every man wants to own his own shop, yet there are dangers in building too soon. This course may absorb working capital that you will sorely need in the development of the business. You cannot tell accurately just how you will want your layout until you have been manufacturing for a period. Your plans may be modified by the nature of the public's response to your selling effort. To my mind, it pays to rent at first rather than build your factory.

At times too, consideration may also be given to having the parts made from your own tools in outside shops. This will depend upon certain factors. If the cost of your product lies mainly in the machine room operations, then it will usually pay to install your own equipment, especially if the market selling price does not allow a large profit. If, however, the cost of assembling is the main factor, then manufacture of parts by outside shops under strict inspection supervision may be considered.

The Problem of Equipment

Of course, I am assuming that you are starting under moderate financial conditions, as the majority of concerns begin. You must save your liquid capital for your marketing operations. It is surprising how a machine room will absorb capital. You get the figure upon your machine equipment and think that that sum represents the bulk of your investment. When you are through with paying for your belting, shafting foundations, small tool equipment and similar items, you find that your estimate was entirely too small.

However, we will assume that you will buy the entire equipment and run your own shop. The first thing is the determination of the type and quantities of machine tool equipment you will need. This is a job that must be worked out with care. Guesswork must be eliminated. We often find that the equipment is badly unbalanced, owing to carelessness in working out the machine requirements.

The accurate method is to analyze the production of each part into its separate operations, showing each needed machine tool, then show the output per hour possible, and compare this amount with your required production to get the percentage of the possible output that is needed for each operation. By grouping together the per cents according to machine tools, you will get correctly the needed capacity of each machine. This method is fully described under "Costs."

Factory Layout

Manufacturers are just beginning to recognize the great importance of factory layout, arranging the shop equipment so that the flow of parts will be in a line as far as possible. Henry Ford showed us how it should be done.

Now, Mr. Reader, don't say to yourself, "That's all right with Ford with *his* product but it won't work with mine." How do you know it won't? Because Ford has one product and you have ten or more?

Try this: Take each of your products and divide the parts into two divisions—group A to contain all the parts that are difficult to manufacture or that have a large number of operations and group B to contain the balance of the parts. I'll predict that you will be surprised to see how small the first group is and how large the number of "easy" parts in group B amounts to. Do this with each of your products.

Try to group your manufacturing tools so that these two groups may be separated even though you may require a few more machine tools to do it. Then study intensively the difficult parts, one by one. This study alone will be beneficial. Then arrange your factory layout so that these parts may be handled in a group by themselves so far as possible.

Scheduling Flow of Parts

Using your desired output as a basis, also the length of time required in the shop for production, schedule the starting of the orders—the progress through the factory—and the arrival in the finished stock rooms. Then organize your force so that this schedule will be maintained.

The other group of less difficult parts may be easily handled and produced in quantities.

It will be found a great advantage to keep these two groups well separated. So often delays in production of important parts, with consequent heavy expense, occur, owing to the unimportant parts getting

[1] See MANAGEMENT IN MANUFACTURING, September 1925, pp. 125-128.

in the road in production. Concentration upon the difficult parts is important.

Assembling Layout

Why is it that so often we spend most of our time studying the machine operations, and leave the study of assembling to work out later? Then we start up and allow a foreman who is not familiar with the product to arrange his own assembling. The trouble is that, once we are started, we seldom find time to change for the better.

Ordinarily the assembling costs much more than the machining and is deserving of even more attention. The layout and planning of the assembling is all-important and should receive the attention of the best brains that you have. Pray over your assembling plans and methods. It will pay you. If you have started without doing this, just try it out sometime by taking your designs and laying out the best possible assembling plans without reference to your existing methods. Your present layout and methods will not resemble the new ones nine times out of ten.

This subject is so important that it cannot be properly handled within the limits of this article. With these few hints, which are fundamental, you can work out the problem satisfactorily. I assure you that it will be a great thing for you.

Never overlook the highly important fact that, if you can speed up production and get the parts moving faster, you are making your dollars work faster for you and you are not tying up your precious working capital longer than you need to. And the way your shop will eat up that capital is astonishing.

Determine the rate of output you will start with and the production at which you will cover expenses, and also your future rates of increase.

One of the most important calculations that you can make is the determination of what output you will aim at for the start. Naturally you will first attempt to get upon such an output basis that your returns from sales will cover your factory costs for labor and material—factory overhead—selling and executive expense.

Very often this is purely guesswork, called an "estimate," which is based upon hope of a larger profit than is warranted. The result is that working capital is lost and absorbed to a greater degree than was ever calculated and thus your little company soon faces a crisis.

It is very easy to become enthusiastic when the start is once made and dissipate your precious capital quickly through too large salaries, too expensive equipment, too great stocks of material, and especially through taking too much time to reach an output basis that is set too high.

You must remember that before you get any machines "going out of the shipping door," you have got to buy and pay for labor and material not only sufficient for these particular machines but also enough to fill up all of the jobs in the shop intervening between the start and finish of production.

Then too, don't overlook the fact that you have got to wait probably 60 days for your money from your customer before you get any back and therefore you must be provided with enough to bridge over this gap.

Times without number I have seen these highly important points overlooked with the result that the little company has run out of working capital completely before it gets a good start, with the further result that other interests have assumed control and the originators have been frozen out.

Of course you might well claim that such failures are due to "shortage of working capital," yet it is really due to improper and unwise use of the capital.

But in spite of all of your enthusiasm, you can bet your last dollar that, if you don't watch out and cover these points, old Mr. Fact is laying for you and will get you before you turn the corner.

I can hear you, Mr. Small Man, say, "That's all very pretty, but if I haven't got the capital to cover all of these points, what am I to do?" There is only one course for you to follow; and nine times out of ten its the wise course no matter how much capital you may have. *Go slowly, and keep that overhead down.* Start small and keep it so until you have thoroughly proved your proposition.

After getting your figures together, calculate what your minimum output must be to cover all expenses. Figure liberally for the unexpected. Then set other standards of production so that you may pass from one stage to another, as your business succeeds, according to a pre-arranged plan, calculating at each step the amount of capital you will need.

Before increasing your production, take a good long survey of the markets that you propose to enter to get your increase. Also look over the strength of your competitors. Will your product enter new markets, or will you take business from your competitor to gain your increase? If the former, the problems are simple; if the latter, then you are in for trouble that must be counted upon before you start. You should be especially strong in your capital position.

As I will bring out later under "Capital," do not assume that you will secure the same percentage of profit in the new competitive markets that you have in the old, for you may be entering a new area of competition. I have seen many a manager fooled in this way. Look all the facts squarely in the face and prepare yourself.

Cost and Production Schedule

Here is the point at which men continually fool themselves. And this usually results fatally. You want to feel that there is a certain profit to be secured for making and marketing your proposed product, and in spite of yourself, you will estimate your costs so that this supposed profit will show on your estimates. Nothing could be more foolish, for here is the place where old Mr. Fact will attend to you. Get away from the profit idea and figure your costs on an actual fact basis.

Then too, a man will figure his costs based upon a larger output than he can possibly reach for a year

at least. What are you going to do during the interval. If your prices are based upon such a cost, you are going to lose money steadily until you reach that production and the chances are that your capital will have disappeared by that time.

The only thing for a sensible man to do is to figure out what output he has the capital for and then figure his costs on that basis. Its all very well to have the figures based upon the larger output in order to show possible profits, but don't base your prices and expectations on these figures at the start.

How to Make Up Your Cost Estimates

Here is where you simply have to deal with detail—no jumping at results will serve. There cannot be any guesswork. The usual estimate is not worth the paper it is written upon. There is but one way, and that is to figure out the cost of each and every part, operation by operation.

You must not neglect to do this, no matter how difficult it may be, for your whole business future will depend upon how carefully and accurately it is done. I emphasize this strenuously as I have seen so much careless, inaccurate figuring, that it seems to be general.

The cost estimate that I propose not only gives you your costs but also provides a real production program. It will provide you with a proper list of machine tools, give you the anticipated output from each tool on each operation, and show you the number of employees, men and women, that you will need. This will serve as an invaluable guide when actual production begins. Fig. 1 shows the form to use. Every part must get this survey.

What does this report show?

Assume that you will send through lots of 5000 at one time, this amount to last four weeks:

1. The labor cost will run at the rate of $3.30 per 1000 (includes set up time).
2. To get out 5000 parts the press on blank and pierce will require 2½ hr. per week or 2½ hr. out of 48, or approximately 5 per cent of its time on this one part.
3. On forming at 600 per hr. the press will be busy 8 hr. 20 min., or approximately 18 per cent of its weekly time.
4. Two burring jobs at 800 per hr. will take 12 hr., 15 min., or 21 per cent.
5. The drilling will take 21 hr., or approximately 44 per cent.

You will see that if you figure out these percentages for each part and then add together the percentages that apply to the same machine tools, you will get the total per cents applying to each machine and thus determine the number of tools of each type needed.

You can also take the columns marked "M" for "man" and "W" for "woman" and can, by applying these same percentages, determine the number of men and women needed for a given output.

NAME AND No. OF PART *Margin Stop Lever #359* DATE *6-10-25*

MATERIAL TO BE USED *C. R. Steel—.050* AMOUNT PER 1000 PARTS *20#*

OPERATIONS	TYPE OF MACHINE TOOL	PRODUCTION PER HR.	OPERATOR		COST PER 1000 PARTS
			Type	Hr. Rate	
Blank and Pierce	*Punch Press*	*2000*	*M*	*$0.60*	*$0.30*
Form	*Punch Press*	*600*	*M*	*0.60*	*1.00*
Burr	*Disc Br*	*800*	*W*	*0.30*	*0.375*
Drill 2 holes	*Drill Press*	*240*	*W*	*0.30*	*1.25*
Burr	*Drill Br*	*800*	*W*	*0.30*	*0.375*
Inspect	*Gage*	*Overhead*			
Stores					
Total labor cost on 1000 # 359					*$3.30*

FIG. 1 COST ESTIMATE THAT PROVIDES COSTS AND GIVES PRODUCTION PROGRAM

By this method you have linked up your estimated production with your costs in such a way as to make a serious error impossible, provided you have calculated, or had calculated for you, the amounts of production that you may expect hourly from each machine tool. If you are not able to get the latter data, then of course you can never get an accurate estimate. The data on the tools themselves and their capacity will give you most of what you need, and most good foremen will supply the rest.

I have always found these reports of great value in checking up the estimates with actual production results. The possession of such data makes it possible for you to lay out a real production program. It permits you to separate the difficult and long jobs from the easier ones and fits in well with the plan of separation outlined under "Factory Layout."

Your material costs are also easily secured from the data shown.

Overhead

Overhead is always an important subject, but especially so to the industry just starting. I need hardly caution you against the expenditure of a needless dollar; but it is well to remember that, when you spend a dollar of your capital, it does not return. I have seen many cases of wastefulness of these original sums—the salaries of officers were too large; the organization was too elaborate at the start; the overhead was too great.

Don't build up your overhead organization too soon. I have seen cases where production did not get up to the expected level for many months, and the organization, built up too soon, was eating the concern's head off, with nothing to do.

Build up a factory overhead schedule that will show the separate items that make it up. Base this upon the different outputs that you expect to reach from

time to time. Keep your limits at the lowest points, especially at the start. Herein lies the advantage of starting on a small scale. While, of course, the overhead diminishes in per cent as the output increases, still the overhead can be kept low at the start if everyone works on every job possible.

You have now to consider your sales expense and overhead. I deal with this under "Selling Division." Your method of selling must be determined before you can accurately estimate your sales cost. But the estimate must be made. Often this is a matter of pure guesswork. You can wager that, if there is any guessing, it is too low. Look the facts in the face and figure accordingly. It will always cost you more to sell than you imagine.

Then calculate the executive expense. By adding together the results of these surveys you will have an excellent estimate to guide you if you have been conservative throughout.

Nine times out of ten your competitors have determined your selling price for you. Get all possible competitive data on this point and then see what your net return will be when based upon such figures. Usually you will find that you will lose a surprising amount of money until you can get your sales and production up to a certain point, where you will break even.

Determine that point, and then aim for it. When you get to it and then begin to grow, don't get careless about that overhead, but keep referring to that old survey, and don't let it exceed the amount that you set down as allowable amounts.

By this method you have a series of limits that you have set for yourself at different points of your progress, and you know that if you keep within these limits you are going to make money.

This may well be termed "budgeting your expenditures." In this manner you keep a real control of your affairs. Personally I arrange the various budgets that show allowable expenditures on all branches of my business. Then I get returns weekly and monthly showing the actual expenditures on all items, and make my comparisons. As long as expenditures on any item are within the allowable amount, there is nothing to worry about. However, if any item shows a material increase over the allowable figure, an immediate investigation is made. Perhaps the extra amount is all right, but if not, it is stopped at once. This also has a healthy effect upon those responsible for the ordering and buying of materials.

Preventing Excess Inventories

I have found many cases where companies have been seriously crippled and ruined by an undue absorption of capital due to over-large inventories. When the factory has control of ordering raw materials it is much inclined to over-order. Its usual policy is to "have plenty on hand" in stores. That's all very well, but such a policy may mean a raw stock inventory from 30 to 50 per cent too large, and that means a tie-up of money that ought to be in bank. It means losses through interest charges, and, worst of all, really large losses when changes are made in the product that make this material unusable.

The proper method of control that I have developed is simple.

The Treasurer Is Our Traffic Cop

First comes a conference between the general manager, head of sales, factory superintendent, and treasurer of the company. The sales manager states his estimate of sales for six months; the superintendent states his capacity; but Mr. Treasurer states whether or not such programs can be carried out. The requirement that he has laid down is that we must at all times either keep within the limits of our capital or find ways to raise new money. He is in effect our "traffic cop" and tells us whether we go ahead or stop. We must not get ahead of our capital.

Having determined the permissable volume of output and sales, we next have before us a large blanket report from the engineer that shows in detail the amounts of materials of the different kinds that are needed for such a six months' output. These items have been priced so that we know what expenditures are needed.

We therefore see the total needed for material expenditures, and can add thereto the approximate amounts to be spent for labor overhead, sales, and administration. We all authorize these payments by signing the copies. The treasurer then assumes final and absolute control of these expenditures as we place on his shoulders the responsibility of checking all requisitions and purchases against this blanket requisition.

We thus do away with the pernicious system of having every requisition approved by a string of officers who know nothing about any of them and who could not take the time to look them up. You know that the usual result of this common system is for each officer to allow the requisitions to accumulate on his desk until his pile grows too large and then sign them hastily and pass them along to the next officer with the same delay, with the result that the requisitions reach the purchasing department about the time that the materials ought to be coming into the shop.

All requisitions come first to the treasurer, who checks the amounts against the approved amount shown on the blanket requisition. If satisfactory, he approves and sends it to the purchasing department. He, of course, subtracts this amount from the amount allowed, so that he always has before him a balance that may be ordered. In this manner he will keep a check on the stores department and prevent it from over-ordering. Just let a requisition come in that shows an over-order, and an investigation is made at once. It may be either an error in stores or too much scrap in the factory.

The purchasing department makes out its orders from these approved requisitions and sends them to the treasurer before mailing for a final check and approval.

This simple system proves very effective in furnishing control of ordering materials and inventories.

(To be concluded in the November issue.)

Selecting The Proper Container

Factors that the Manufacturer Must Weigh to Bring About Economy in Shipping Costs

WHERE any sort of container is necessary for the shipment of articles manufactured on a production basis, appreciable economies can be brought about by a study to determine the type most suitable for use. Experiments have repeatedly demonstrated that the strongest looking box or crate built in the average shipping room may, in fact, be the weakest. At the same time it almost invariably costs much more in the end than a scientifically developed container.

Each year fewer concerns adopt or continue the practice of making their own shipping containers. Box and crate making have become distinct industries in themselves. In addition, the research and engineering skill, experience and facilities of the container manufacturers have developed better and cheaper products than most individual plants could turn out. With the container manufacturer, the making of such commodities is a business, but with the user it is only a troublesome branch of plant activity which far more economically can be relinquished to specialists in this line, for study and successful accomplishment.

Few Plants Can Profitably Make Their Own Containers

There are only four types of manufacturing plants that can profitably make their own shipping containers:

1. Those making heavy products, like automobiles, machines, machine parts, etc.
2. Those engaged in wood working industries, such as furniture manufacturers, where lumber is handled on a production basis with trained men, efficient equipment and good management.
3. Very large concerns where the volume of work requires the best equipment and methods, as in the Tide Water Oil Company,[1] Ford Motor Company,[2] etc.
4. Small concerns, or those engaged in a wide variety of work, where containers are made in limited quantities, or of varying shapes and sizes.

Aside from the question of whether it is more profitable to make or to buy shipping containers, the following factors enter into the consideration of every container problem for the general line of manufactured products:

1. Average volume of production in the plant
2. Nature of product:
   - (a) Bulk or unit
   - (b) Size and weight of units
   - (c) Package containing unit
   - (d) Fragile or rugged
   - (e) Perishable or staple
   - (f) Susceptibility to weather conditions
   - (g) Relative value of product
3. Safety in shipment
4. First cost
5. Relative strength
6. Relative weight
7. Size of container
8. Shape of container
9. Distance of shipment
10. Routes of transportation
11. Handling in transportation
12. Protection from elements
13. Protection against theft
14. Freight rates
15. Possibility of container standardization
16. Storage space
17. Assembly work on containers
18. Relative cost of packing
19. Cost of purchasing and operating accessory equipment
20. Salvage value of containers
21. Convenience and saving to dealers
22. Sales appeal of containers
23. Special requirements
24. Legal requirements

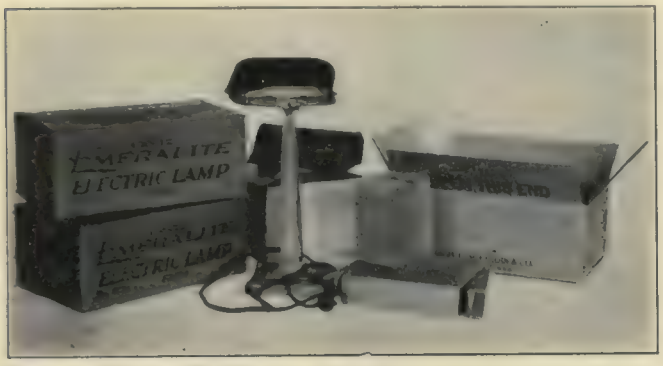
Volume of Production. Where volumes are large, the cheapest and lightest container that will render effective service is advisable. Initial cost and freight charges run into such large sums that a small saving on each unit aggregates a large annual total. This eliminates the ordinary wood box. Where quantities are smaller, other factors are relatively of more importance.

Nature of Product. Bulk products require a tightly closed container, often of metal. Unit products like wash boilers, auto fenders, etc., can be shipped in wirebound crates. Canned goods, wearing apparel, and other small units, including even articles of furniture, ship with entire satisfaction in fiberboard containers. Larger units, especially if heavy, require wirebound or strapped boxes or crates. Articles well protected in inner packages can safely be put in light containers. Those not so packed need a stouter outside case. Fragile articles can be made safe in any well

[1] See MANAGEMENT IN MANUFACTURING, July 1924, pp. 59-64, "Packaging and Shipping Oil and Lubricants," by J. B. Edwards.

[2] See MANAGEMENT IN MANUFACTURING, July 1925, pp. 33-36, "$15,000,000 Salvaged by Ford Plants."

designed type of container by proper interior partitions, cushions, or wrappings. (See Fig. 1.) Rugged items need only the outer protection. Fruits, berries and vegetables of a wet and quickly perishable nature suffer less injury if carried in open crates. Drier or heavily skinned fruits and vegetables such as grape fruit, oranges, apples, potatoes, etc., carry without spoiling in fiberboard containers, and few dry staple groceries are now shipped in anything but this type.



Courtesy of National Container Association

FIG. 1 FRAGILE ARTICLES ARE PROTECTED BY INTERIOR PACKING

Wood boxes are best for certain articles that are susceptible to severe weather conditions or suffer injury if stored in very wet places. Relatively expensive containers are justifiable for costly products.

Safety in Shipment. Both fiberboard and wirebound boxes are rapidly replacing wood boxes in both domestic and foreign commerce because of their equivalent or greater safety coincident with their greatly reduced weight. The former are very resilient against shocks, while the latter better withstand puncturing from external objects.

First Cost. Fiber containers are undoubtedly cheaper, but this should be the deciding factor only when all other factors balance between wood, wirebound and fiberboard containers.

Relative Strength. Both fiberboard (particularly if of corrugated strawboard) and wirebound boxes are much stronger than wood boxes of equal weight and cost. Wirebound crates are also stronger than ordinary crates. Regular wood boxes and crates, if used, should conform to the specifications developed by the Forest Products Laboratory, at Madison, Wisconsin, or the Freight Container Bureau of the American Railway Association.[3]

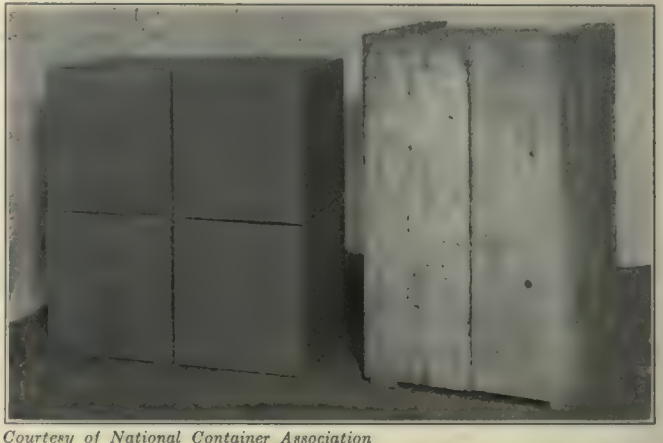
Size of Container. Containers should be designed for as many units as shipping regulations and selling practices permit. Where articles are small but it is desirable to sell them in original boxes, as radio parts, these boxes can be packed in larger containers in whatever quantity is convenient. Certain objects, like vacuum cleaners, groups of electric fixtures, oil stoves, small articles of furniture, etc., are best sold assembled and are large enough to require a separate container. Handling requirements in transit, however, limit the size of containers. Wherever possible, they should be no bigger than one man can easily lift. Then they will receive more careful treatment and will suffer less injury. Very little extra trouble is involved in checking and keeping track of the extra number of containers, and their total cost is less than for larger sizes. (See Fig. 2.)

Shape. The shape of containers is regulated by the shape and size of contents, requirements for strength, and convenience of handling and transportation. The rectangular prism is the most common and usually the most convenient and economical shape. In wood or wirebound containers sometimes a saving can be effected by adopting a hexagonal, octagonal or even irregular shape.

Distance of Shipment. When articles are to go only a short distance and over routes where they will be carefully handled, a light, cheap container is sufficient. For longer distances a stronger and often heavier type of container must be used.

Routes of Transportation. Where direct motor truck or box car shipments are concerned, a much less sturdy type of container will answer than where transfers must be made, especially to barges or ships.

Handling in Transportation. Where many transfers are necessary during transit, and where hand labor figures largely in the work, cases must be stronger than where direct shipments are possible, and mechanical equipment is available for loading containers from one carrier to another. Smaller containers carry safer where hand labor is employed because they are relatively stronger and usually receive more careful handling. Fiberboard and wirebound containers stand



Courtesy of National Container Association

FIG. 2 FOUR FIBER BOXES REPLACE ONE WOOD CASE

up under rough handling much better than regular wood boxes.

Protection from Elements. Under ordinary conditions any type of container is suitable if the interior wrapping is good, or if contents are not easily affected by water and dust which may penetrate through. The fiberboard box is tighter than any other type, as it is sealed. The corrugated kind does not easily admit water even when the outside becomes quite wet. For the worst conditions, a wood container with suitable water and dust-proof wrapping around the contents is best.

(To be concluded in the November issue.)

[3] See Management's Handbook, pp. 1119-1168, "Shipping Containers."

Worthington Methods Cut Tool Costs

Development and Maintenance Control Results in Large Savings

By ANKER L. CHRISTENSEN

Engineer, Tool and Material Storage Department, Worthington Pump and Machinery Corporation

THE problem of keeping a large factory adequately supplied with proper tools is a very important one.[1] In fact, many companies maintain a department under an engineer whose time is given over to procuring and maintaining the productive equipment. Tool development is in a state of perpetual change and progress, and every up-to-date factory is constantly testing and developing new and better tools.

Generally speaking, the output of a machine tool is in proportion to the capacity of a very few ounces of steel at the cutting tip. In the parlance of the shop: "It all depends on the business edge." Sometimes the mere changing of the shape of a cutting tool, or the method of hardening or the kind of steel used may speed up the production on an expensive machine to a point where the saving is many times the cost of the change.

The important features in keeping tools up to a high efficiency are:

1. Complete records of what tools are available.
2. Tool inventory control so that changes can be made with the least possible delay, confusion and scrapping of the serviceable tools whose use is being discontinued.
3. Constant vigilance for new and better things in tool construction.

Before adopting a new tool it should be subject to thorough shop tests. These tests should be conducted on every new tool regardless of where it came from. Suggestions from company employees should receive the same consideration as those from representatives of tool manufacturers.

A careful record should be made of each and every tool that is on trial in the factory. This record should show the following information:

1. Name and description of the tool.
2. Manufacturer's name.
3. Cost of tool per unit.
4. What accessories are necessary, and their cost.
5. What tool now in use it is to replace.
6. What the advantages will be:
   (a) Increased production.
   (b) Decreased tool cost.
7. Whether there are any features that are not in accordance with "safety first" principles.
8. What are the estimated yearly savings effected:
   (a) Show cost under present method.
   (b) Show estimated future cost.
   (c) Show the quantity of materials manufactured yearly that this tool will be used on.

A standard form should be worked out for this data. These records should be filed in the equipment engineer's office for reference. Each and every time that a new kind of tool is needed, one of the above data forms should be made out and sent to the equipment engineer who will, if he approves of trying the tool, authorize its purchase or manufacture. Such orders should bear the statement "Required for Trial or Experimental Purposes." The equipment engineer then issues instructions as to what nature of test will be necessary adequately to try out the new tool. Careful records of the performance of the tools should be kept and notations made on the original applications. At the completion of the tests, the equipment engineer will (if the new tools are found satisfactory and approved) issue instructions as to the disposition of the old tools that the new ones are to replace.

The problem of disposing of tools that have become obsolete is closely connected with that of keeping the tools up to date. Old and obsolete tools accumulate with surprising rapidity. This is especially true with large factories that carry on a great variety of manufacturing, particularly in industries where rapid development is in progress. The three sources of obsolete tools are:

1. Development of better tools.
2. Changing methods of machining.
3. Product manufacture discontinued.

Development of Better and More Efficient Tools. The process of tool development is constantly going on in every progressive factory. Nearly every day brings forth changes and inventions which are better in some respects than those now in use, with the result that it is necessary to install the new and scrap the old stock.

Changing Methods of Machining. The shop workmen are constantly finding new and better ways of doing things. This sometimes takes the form of rearrangement of tool set-ups on the same machine, and in other cases a change in the type of machine used. The change usually makes some of the tools obsolete.

[1] See MANAGEMENT IN MANUFACTURING, May 1925, pp. 467-470; June 1925, pp. 537-540; July 1925, pp. 15-18; August 1925, pp. 95-97; September 1925, pp. 141-144, for previous articles on Worthington tool control methods.

Discontinuation of Product. Patterns and models of the product are constantly becoming obsolete. The engineering department has the authority to destroy

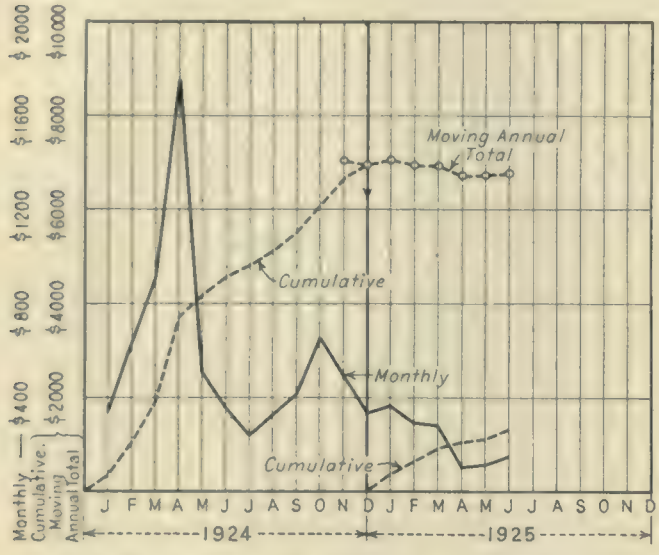


FIG. 13. COST OF TWIST DRILL REPAIRS AND REPLACEMENTS

such patterns. It is obvious that if the pattern no longer exists, there can be little reason for keeping the tools that were used solely in making that pattern.

Scrapping Obsolete Tools

The problem of disposing of worn or obsolete tools is a difficult one. Whether a tool should be salvaged for another job or repaired for further service requires careful study of conditions. It is easy to spend $2 to save $1 in salvage work. Oftentimes it is cheaper to scrap a comparatively new tool than to use it up. For example, it would be poor economy for a factory to wear out a lot of used carbon steel taps or drills when production could be doubled by the use of high speed tools. On the other hand, a loose policy of scrapping is sure to send good and serviceable tools to the scrap box. This is especially true where damaged tool reports are not carefully kept.

In the case of tools becoming obsolete by the introduction of better tools it is usually the better policy to err on the side of scrapping serviceable tools than to attempt to spend money on salvaging processes. When methods of machining are changed, it is often possible to use all the tools not strictly special to the particular job on other work. When a product is discontinued, the special tools may be written off the inventory as scrap but held in some place for a limited time to be used for repair work, and when the repair work on that particular product becomes inactive the special tools may be actually disposed of as scrap.

Tool Inventories. If the number of tools on hand for each particular item is properly controlled, then the change to a better tool, when such a course becomes necessary, is a comparatively simple process. Discarding the old idea that tool maintenance should be low when compared on a percentage basis of the total inventory, and adopting the principle of getting the most practicable units of work out of a tool by wearing it out as quickly as possible, tends toward better tool control. There is an idea in some shops that tool replacements and repairs should equal from 10 to 20 per cent of the total inventory. But when this is applied to individual tools the fallacy is apparent, i.e., the maximum rate of 20 per cent on twist drills would mean an inventory large enough to last five years. Practically all standard drills can be purchased from stock with the maximum of a month's time elapsed from the time the order is placed. In this case a repair and replacement ratio of 200 per cent would be far more economical than one of 20 per cent.

Thus it is easily apparent that by keeping tool inventory on a strict requirement basis, bearing in mind the lag between ordering and receiving the goods, any improvement can be made with very little confusion and cost. It was found in one shop that by changing from a special shank on machine taps to the standard hand tap shanks, a saving of nearly 40 per cent could be effected. This saving was sufficient to pay for the necessary adapters in less than a year.

The figures showing the number of individual tools in each group that is to be kept in the tool crib should be worked out from actual experience as to how many of each is generally used. The standard tool lists give valuable aid in this work. After these figures are determined, a study should be made of the most economical ordering units either by purchase or from manufacture within the factory; for example, on ⅝ in. machine taps, the best manufacturing quantity is about 100 and the most economical purchase unit is one gross or above. However, this quantity is too great to keep in the tool crib, because if the crib is allowed too many tools of any specific item, the tendency is to give out new tools instead of using the old ones until they are worn out. If this practice were permitted, a large

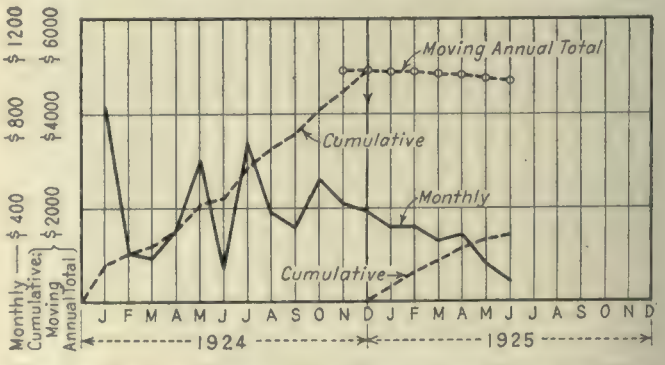


FIG. 14 COST OF MACHINE TAP REPAIRS AND REPLACEMENTS

number of semi-worn tools would accumulate in a very short time. Therefore, any excess of tools should be kept in the storeroom and disbursed to the tool crib as needed to keep its stock at the specified quantity.

Manufacturing Versus Purchase of Tools

The question whether to purchase or manufacture tools may generally be decided on the price and service basis. As a rule, standard tools that can be purchased

in the open market when produced in sufficient quantities to insure competition, can be secured more cheaply and give better service than those made in the factory's own tool rooms. It is only logical to suppose that companies specializing in the manufacture of tools can do a better job than those that merely use the tools in the manufacture of some special product. On the other hand, if the tool room can produce tools of equal quality, and cheaper than the manufacturers will sell them for, they should be permitted to do so.

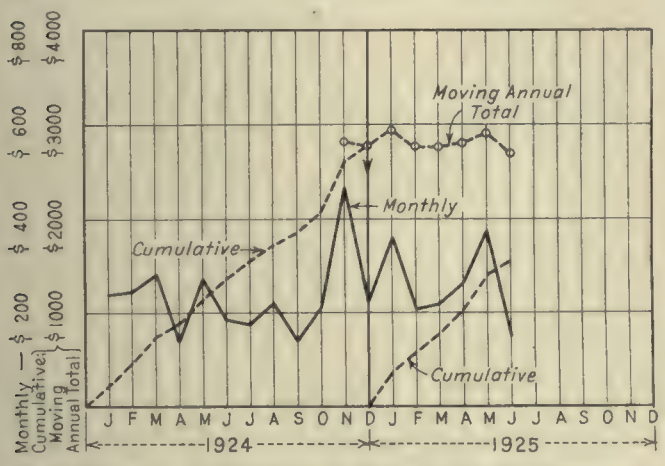


FIG. 15 COST OF COUNTERBORE REPAIRS AND REPLACEMENTS

In deciding upon the advisability of manufacturing or purchasing tools, the following points should be considered:

1. Cost of making versus buying of tools. Care should be taken to consider all elements of cost in manufacturing tools, including burden. Tool rooms do not as a rule have burden applied, since they are rated as non-productive. The fact remains, however, that power is absorbed, machines and tools worn out, floor space occupied, and light supplied in the tool room as well as in any other shop, whether these items are charged to the cost of making tools or not.
2. Tool breakage due to poor workmanship, wrong dimensions, flaws in the steel and improper hardening, is rather high. Replacement of tools thus damaged is done without cost by all the reputable tool manufacturers. On the other hand, when a factory manufactures its own tools, breakages from above causes are non-recoverable losses.
3. Closely connected with the original costs of production is the service a tool gives. A tap that costs 50 per cent more to purchase than to make should thread 50 per cent more holes in order to justify the additional cost. But if it produces 100 per cent or even 75 per cent more holes, than the purchased tap would be the more economical. As a rule, tools that can be made on a productive basis by tool manufacturers should be closely investigated before any attempt is made to produce them in preference to buying them. However, special tools that have to be manufactured on a special order by an outside firm can generally be made cheaper by the factory itself.

Every effort should be made to utilize standard tools as far as practicable and special tools should be resorted to only when they will give better results than standard. There are occasions, however, when it is necessary for a company to develop a tool for some particular work because:

1. The standard tools in the market will not do.
2. The special tools that are made by tool companies are not satisfactory.
3. Good ideas for new tools for special purposes may be brought out by a company's personnel which tool companies would be unwilling to manufacture for a reasonable price.
4. Special tools that are needed in a hurry can generally be made more advantageously in the company's own tool room.

The most serious difficulty a firm finds in making its own tools is that of proper heat treating, since it is usually not so well equipped for that process as regular tool companies. However, there are generally available to most factories special heat treating concerns that do hardening work.

Systematic tool development can best be carried on where good records are available for the performance and cost of maintenance on each class of tools.[1] A system of classified tool repair numbers was fully explained in a recent issue of this magazine.[2] The accumulated charges for each class of tools are summed up at the end of each month and compared with past performances. In order to bring out the facts more clearly, the well known Z-chart graphs can be used, a curve being kept for each class of tools.[3] Figs. 13, 14 and 15 show graphically the maintenance costs for three classes of tools at Worthington Works.

A short study of the charts in conjunction with local shop conditions brought out the facts that the maintenance and development of each class of tools must be given an individual solution. The three charts illustrate this point very clearly. It will be noted on Fig. 13 that the maintenance on twist drills was high for 1924. As it was not practicable for the shop to manufacture its own drills the problem narrowed down to:

1. Testing of various makes of drills in order to get one best suited to our shop conditions.
2. Investigation of how the tools were being used.
3. Checking up on how drills were being sharpened.

A careful examination of several kinds of drills disclosed the fact that several makes were suitable for the conditions in the shop. This reduced the problem to a consideration of local conditions. Improved sharpening methods and a close scrutiny of all damaged drills—with prompt action towards eliminating unnecessary damage—has resulted in a considerable saving in drills as well as a betterment of drilling operations. By extending the cumulative line for 1925 on Fig. 13 at the present slope, the drill maintenance for the year will be about $3500 as compared to approximately $7000 for 1924. There is a small cor-

[2] See MANAGEMENT IN MANUFACTURING, August 1925, pp. 96-97.

[3] For a complete explanation of Z-charts see Management's Handbook, pp. 154-161.

rection in this ratio because the shop has operated during 1925 at about 80 per cent of the 1924 rate.

Reducing Costs on Machine Taps

The case with machine taps as shown by Fig. 14 proved to be one of changing from taps with special type shanks to standard hand taps. It was found that these special shanks increased the cost about 35 per cent and added nothing to the life of the taps. The cost of installing tap drivers to fit standard hand tap shanks could be saved in about a year's time. By letting the supply of the old type of taps run very low and by replacing each size with new taps and drivers as the individual sizes wore out, the change was made with very little confusion, and with practically none of the obsolete type of taps left unused. Fig. 14 shows a steady decline in tap maintenance since October 1924. The new equipment became effective about February 1925, and the monthly maintenance decline before this period—as shown on the curve—was due to strict curtailment of replacements on the old style of taps.

Maintenance on counterboring equipment presents a unique problem. Spot facing comprises the greater part of counterboring work at this factory. The operation consists simply of truing up the faces of rough casting to make a good seat for the nuts where a bolted joint is made. While the cut is shallow and a comparatively small amount of material is removed, it is necessary to break through surface scale on every cut. This is very hard on cutting edges, and necessitates frequent grinding of the tools. The difficult nature of the operation, combined with piece-work production, makes it necessary that the tools have the following advantages to a high degree:

1. Sturdy construction.
2. Simple parts.
3. High speed operation.
4. Comparatively low initial cost.
5. Easy to sharpen and keep in repair.

Since the monthly maintenance curve on Fig. 15 showed a steady increase in cost, a careful study was made to determine what the best solution to this problem would be. An examination was first made of the tools in use as to construction features, material used, and method of heat treating. Next, a few representative samples of the tools furnished by the leading manufacturers were procured. Careful tests were made of each tool working under our shop conditions. Comparisons were made of the performances of each tool with the tools already in continuous use. Their strong and weak points were carefully noted and compared. These facts and figures showed that none of the tools tested were entirely satisfactory for our conditions. The next step was to look into designing a tool that would be suited for our service. Suggestions were accepted from the shop and given a trial. A new model counterbore was then designed which (1) is so strongly constructed that it will stand the roughest treatment of the piece-work operator; (2) is so simply made that the average worker can sharpen it correctly on the shop wheels in a short time; (3) is constructed so as to give the maximum life while cutting continuously through cast iron foundry scale; and (4) is designed so that it can be produced in the tool room with standard equipment at a low cost—using material for its component parts that is best suited for the purpose intended.

Judging from the test results, it is fully expected that this tool will reduce the average monthly maintenance charges on counterbores by at least 50 per cent. Careful check will be made each month against the curve shown on Fig. 15 to see that the new tools live up to expectations, and, if not, the reason will be ascertained.

The three foregoing examples are representative of what can be expected in each class of tools. In conclusion, it is emphasized that only through systematic records of available tools, showing what may be expected of a tool and what each tool is really doing, together with an eternal vigilance for better tools, can a factory be kept up to a high point of operating efficiency.

Making Tools to Drawings

No tool should be made in the tool room without a sketch or drawing. A vast amount of trouble arises from the practice of making tools to samples. Dimensions cannot be accurately taken from worn-out tools and any errors in the original tools will perpetuate themselves, and in many cases become accumulative. A tool maker, when working to sample, often makes many changes in details that he thinks are better, or that make it easier for him to produce the tool. This may be an improvement, but the next time the tool is to be made another man may be given the job and he decides to make a few more changes. Consequently the tools are not alike and their component parts are not interchangeable. Another source of trouble is that friction arises between the tool room and the mechanics in the production department as to the best type of tools to use. The tool inspector does not have tangible dimensions where tools are made to sample, as he does when drawings are used.

The cost of making up drawings is considerable, but the resulting benefits of having the tools made to standard will more than compensate for the cost of the drawings. Table drawings can be made up for a great many classes of tools. These give an outline sketch of the tool, and all the necessary dimensions for the size of the tool are given in an accompanying table. The use of these table drawings is of material aid in standardization and also in eliminating a great many individual drawings.

When tools of a new design are needed, or changes in the old ones are necessary, a sketch should be made up giving details of the tools and showing which tools they are to supersede in case of change. By this method, the equipment engineer may keep in close contact with the tool development of his own factory, as well as the sources of improved methods, ideas, and changes that are constantly being made in outside factories.

Ford Plant Enlarges Power Capacity

Equipment Being Installed Will Make River Rouge Power Plant One of the Largest Steam Turbo-Generator Stations in America

By GEORGE E. HAGEMANN

Associate Editor, MANAGEMENT IN MANUFACTURING

MANAGEMENT and manufacturing developments in the Ford industries are of such massive proportions that operations, which by themselves would loom up gigantically, are somewhat dwarfed when viewed as units of the whole organization. Hence it is sometimes forgotten that Henry Ford was at one time chief engineer of the Detroit Edison Company, and throughout his entire career as a successful manufacturer, has paid special attention to the economical generation of power as one of the vital points in operating his industries.

The Ford Motor Company was large enough, and by all means progressive enough to tackle the power question from the standpoint of fundamentals. Original research and experiments have been made for a number of years under the direction of able engineers, and ample resources have been placed at their disposal to follow results to logical conclusions, always with the idea of ultimate economy, cutting out useless equipment and materials, simplifying and reducing the expense of operation, and producing power in the locality concerned under the most favorable conditions and at the lowest possible cost.

Investigations have covered oil and gas engines, steam engines, steam turbines, electric generators, and all the auxiliaries for the most economical conversion of steam power into electrical energy. Much equipment has been designed and built at the Ford plants as a result of facts developed by these investigations.

The boiler room has also received careful attention, and as a consequence radical steps have been taken in designing steam generating equipment and all the auxiliaries connected with the process. Back beyond this, even the preparation of fuels and the application of waste gases from industrial operations have been thoroughly studied, so that the cheapest and best combustible might be obtained, processed and delivered to the boilers in the least expensive manner.

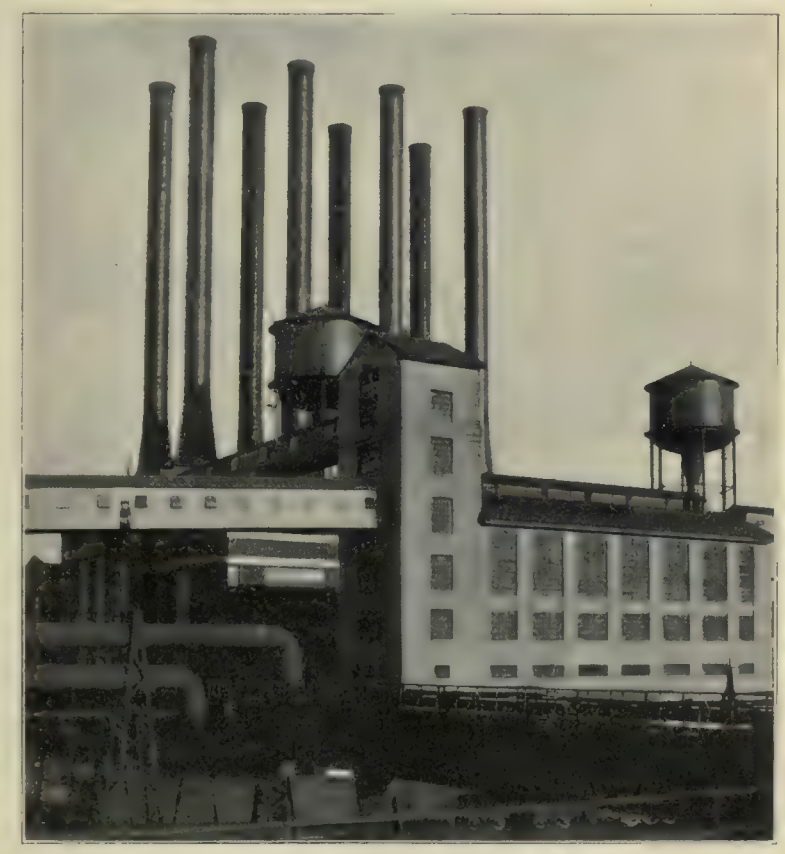


FIG. 1 EXTERIOR VIEW OF POWER HOUSE

Showing coal conveyor bridge, and, from front to back, respectively, the pulverizer building, blast furnace blower room, boiler room, and generator room.

Hydro-electric development has likewise received its full share of attention, and the Ford stations of this nature, both large and small, represent the latest advances in effective and economical utilization of water power. But the River Rouge plant has no available supply of such power, and is not near enough to any source to make the transmission of current profitable. Hence an immense turbo-generator station offers by far the most economical method of producing the large power output required by the great Ford plants located at Detroit. (See Fig. 1.)

The power plant, although already large, is not yet complete. The original turbo-generator units were two General Electric 12,500 kw. machines. Then a 30,000 kva. unit of Ford design and manufacture was installed. (See Figs. 2 and 3.) Finally, after exhaustive research, a 62,500 hp. machine was designed and adopted as a standard. Three of these are now in

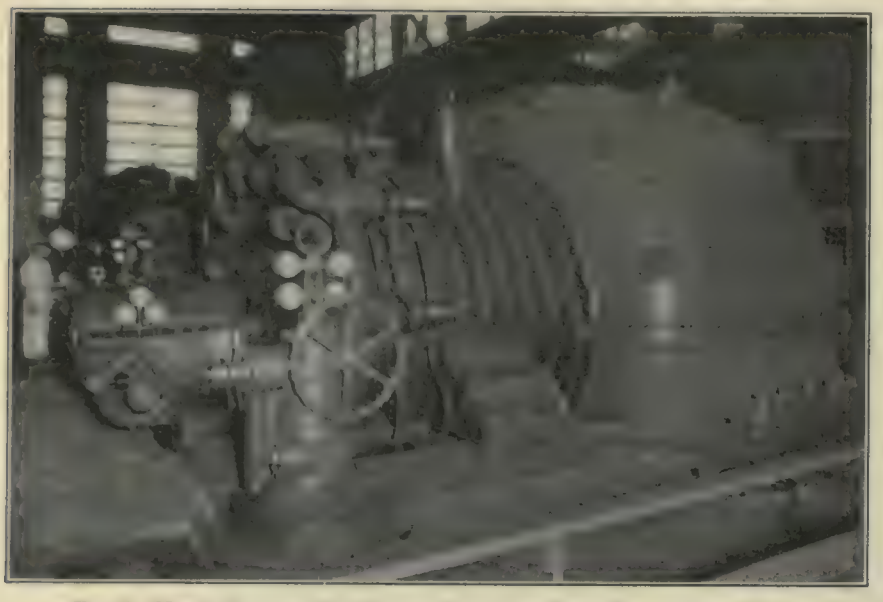


FIG. 2 NO. 6 TURBINE 30,000 KVA. CAPACITY, FORD DESIGN AND MAKE

commission, having been installed during 1925. Three more are in course of manufacture and erection. Eventually two additional units will be added, making a total of eight, with a combined capacity of 500,000 hp. The River Rouge power plant will then be one of the largest turbo-generator stations in America.

Eighty thousand horsepower is sufficient for the production of 10,000 Ford cars per day, the present average output. The remainder of the power will be used at the Lincoln plant, for electric furnaces and miscellaneous industrial purposes, and for the Detroit, Toledo and Ironton Railroad, one branch of which 17 miles long, is already electrified.

The power house is located toward the middle of the River Rouge plant yard, between the coal handling and distillation plants on the one side and the manufacturing buildings on the other. It is of steel and reinforced concrete construction, with brick outer walls trimmed in stone. The main portion of the building, containing the boilers, is six stories high. The adjacent sections, as shown in Fig. 1, are somewhat lower. In the one to the far right of the main structure in the photograph, coal used as fuel is pulverized and elevated to the screw conveyors. The one immediately to the right of the main structure is the blast furnace blower room. The boiler room is in the next section, and in the portion farthest to the left the turbo-generators and auxiliaries are located. The covered bridge in the photograph houses the coal conveyor to the power house.

The present steam generating equipment consists of eight 2647 hp. George T. Ladd boilers. Each of these has a double-ended furnace. The Lupulco system of firing is used, and pulverized coal and blast furnace gas are the fuels. The coal is obtained from the Ford mines at Banner Fork, Kentucky. The gas is a by-product from the reduction of iron ore in furnaces adjacent to the power house. It is introduced near the bottom of the boiler furnace at each corner and the powdered coal is fed in from the top at each end, at a point 25 ft. higher. The furnace is 30 ft. square and 30 ft. high. The mixture of gas and coal is proportioned and burned to reach maximum temperature before striking the boiler tubes, which are 25 ft. high. After passing over the tubes, the gases circulate around superheaters and thence up the stack. No economizers are used. The total interior height of each boiler is 70 ft., the exterior height 84 ft.

Steam is generated at 250 lb. pressure and about 650 deg. fahr. total temperature, or a superheat of 250 deg. Natural draft is furnished by eight steel stacks each 333 ft. high and 13 ft. inside diameter at the top.

In contrast to usual methods, the boilers are not supported directly on the foundations beneath them, but are hung from above on steel framework. Because of their large size and the high temperature to which they are subject, this method lowers maintenance charges and adds to efficiency, due to the absence of cracks and settling of the furnace walls.

Boilers are operated continuously day and night. On account of the nature of the fuels, combustion is complete, and practically no smoke is produced. The boiler tubes transfer to the water as high as 90 per cent of the available heat. About 100 tons of coal are burned per boiler each day, but from this only 2 tons of ashes are produced. Hence the problem of ash handling and removal is almost insignificant. The little slag and ash which is produced is discharged on a small car in the basement and taken to the dump.

Another important operating economy connected with the use of the combined fuel is the fact that boilers can be run without interruption for a period of from six months to one year, as compared to the usual shutdown every couple of months in the average industrial power house. Of course, this condition is also partly due to the use of condensed steam for boiler feed and the supplying of evaporated water as make-up, which eliminates trouble from boiler scale.

Furnaces are also equipped to burn oil and tar in case of emergency. The shift from one combination of fuel to another is made while the boilers are in operation and

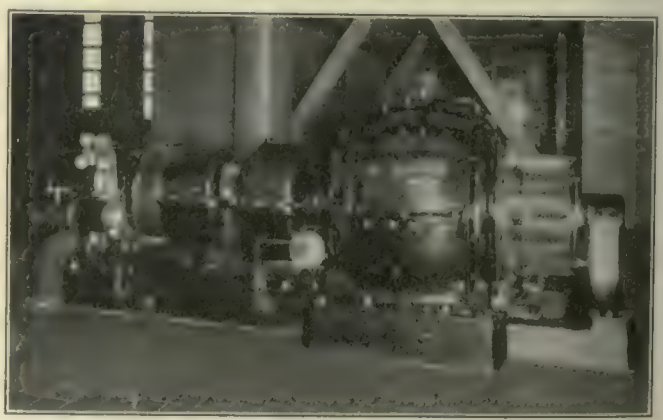


FIG. 3 EXCITER SET FOR 30,000 KVA. TURBINE

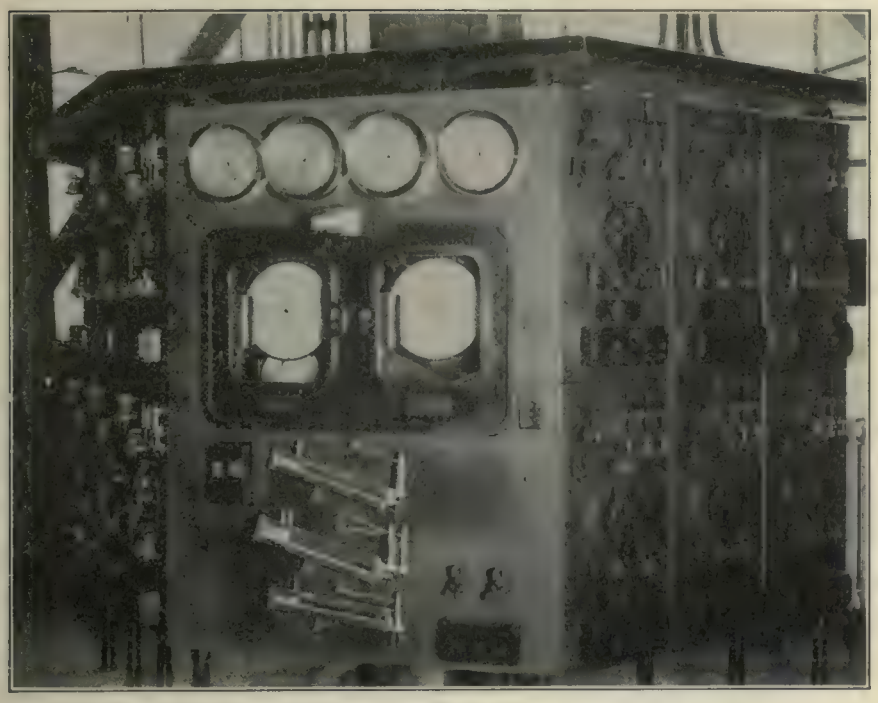


FIG. 4 FIREMAN'S OPERATING BOARD, ONE FOR EACH BOILER
Each of the 12 coal feeders has its own panel.

without loss in heat or drop in efficiency of the furnace.

The absence of the usual forms of coal and the substitution of internal firing for ordinary external feeding of fuel make the boiler room exceptionally clean. This extreme cleanliness is typified by the fact that boilers, walls, ceilings, floors and equipment are painted dark gray and enameled. Various attachments and inspection doors on the boilers are painted with aluminum paint. Boiler room attendants dress in white uniforms and caps. The passing of the old hand-firing methods is typified by mounting a nickel-plated shovel, slice bar, hoe, etc., on a panel as museum pieces.

Control of boiler room operation has been reduced to a highly simplified procedure. One attendant watches the control boards of four boilers. (See Fig. 4.) He takes half-hourly readings, as shown in Fig. 5. The feed of blast furnace gas is set at the correct amount and kept constant. The attendant watches the gages and the indicator showing the boiler pressure. If this pressure drops he increases the supply of pulverized coal, and if it rises he decreases the coal supply. The only other apparatus which he regulates is the draft, which he controls by means of a lever operating a damper in the stack.

The coal is fed to each boiler by means of screws driven by a series of motors; and, by shutting them down or starting them up, one by one, the correct amount of the fuel is supplied to maintain constant steam pressure. Motors are operated from the instrument board connected with each boiler. There are two buttons for each motor, one to start and one to stop. By operating these buttons, the attendant maintains the proper flow of coal to keep up steam. An interlocking control regulates the coal pulverizers and the screw conveyors which feed the fuel into the boiler house, and which are operated from one central panel board.

Main control of each boiler is established by means

FORD MOTOR COMPANY—ROUGE PLANT

DAILY LOG BOILER OPERATION.....Shift No. 2.....BOILER NO..... 5.....1-9-25

TIME	STEAM PRESSURE	FURNACE TEMPERATURE				STACK TEMP.		FURN. DRAFT IN.	STEAM FLOW	STACK DRAFT IN.	AIR PRESS IN.	FLUES BLOWN	COUNTER REV.	CO_2 %		STEAM TEMP.	GAS OFF
		North Upper	South Upper	North Lower	South Lower	East	West							East	West		
7	242	2400	2420	2380	2400	580	580	0.28	9743	1.10	7		12	15		615	
	243	2440	2460			600	600	0.26	9751	1.30	7	11.30	11	15		620	
8	245	2460	2480			610	610	0.26	9760	1.40	7		11	15		620	
	246	2500	2520			610	610	0.26	9768	1.45	7	10	11	15.5		615	
9	246	2500	2540			615	615	0.26	9776	1.45	7		11	15.5		615	
	246	2520	2540			620	620	0.24	9784	1.45	7	11.55	11	15.5		615	
10	246	2540	2560	Estimated	Estimated	620	620	0.24	9793	1.45	7		11	15.5		610	
	246	2540	2560			610	610	0.24	9800	1.45	7		12	15.5		610	
11	244	2500	2500			580	580	0.30	9807	1.00	7		11	15.5		610	
	244	2480	2500			590	580	0.30	9814	1.00	7		11	15		610	
12	246	2480	2500			580	580	0.26	9822	1.30	7		12	15		620	
	246	2480	2500			590	590	0.26	9830	1.30	7		11	15.5		620	
1	247	2500	2520			600	600	0.26	9838	1.40	7		11	15.5		620	
	246	2480	2520			600	600	0.26	9846	1.40	7		11	15.5		620	
2	246	2460	2500			610	610	0.26	9854	1.40	7		12	15.5		620	
	246	2460	2500			610	610	0.26	9863	1.40	7		12	15.5		620	
3									9871								
Average	245	2483	2507	2380	2400	601	600	0.26	1,280,000	1.32	7	25 min.	11	15.3		616	

REMARKS:.....

OIL USED..... D. T. E. LIGHT..... HEAVY MEDIUM.....

CYLINDER OIL..... COAL OIL..... SIGNED. P. PETERSON.....

FIG. 5 DAILY LOG, ONE SHIFT, ON ONE OF THE BOILERS

FORD MOTOR COMPANY—ROUGE PLANT

POWER HOUSE 1 TURBO-GENERATORS

DATE..1-29-25 WEATHER COND...Fair WATCH NO...2 TURBO-GEN NO. ..1

Time	7	8	9	10	11	12	1	2	REMARKS
Steam temp	545	540	550	550	560	560	550	550	No. 1 and auxiliaries run O.K. for 8 hr.
Main press	215	210	215	215	220	210	215	218	
Chest press	213	205	210	210	120	205	210	213	
First stage press	105	120	118	120	114	118	110	110	1000 amperes on Westinghouse same run O.K. for 8 hr.
Barometer									
Vacuum in.	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	
Abs. back press. in.									
Hyd. gear oil press.	68	68	68	68	68	68	68	68	Secured steam on air wash at 8:30.
Bearings oil press.	16	16	16	16	16	16	16	16	
Thrust oil press.	11	12	12	12	12	12	12	12	
Bearing water press.	20	20	20	20	20	20	20	20	Average vacuum 27.5 in.
Rouge water press.	60	60	60	60	62	60	60	60	
City water press	45	45	45	45	48	45	45	45	One gallon D. T. E. medium used for electrical department.
Cooler oil sup. temp.	126	128	125	122	126	124	122	124	
Cooler oil dis. temp.	110	112	110	108	110	108	108	110	
Turb. end oil temp.	117	118	118	118	118	118	118	120	
Turb. end water temp.	42	42	42	42	42	42	40	40	One gallon D. T. E. medium used for evaporating department.
Center oil temp	150	148	148	148	148	148	148	148	
Center water temp.	60	60	60	60	60	60	60	60	
Gen. end oil. temp.	130	130	130	130	130	132	132	130	
Gen. end. water temp.	50	50	50	50	50	50	50	50	
Exciter bear. temp.	105	108	110	108	110	110	112	110	TOTAL GENERATED KW. HR. 101,300
Air to gen. temp.	86	85	84	80	78	76	74		
Hundreds kw. load	10,000	13,300	13,600	14,000	12,000	12,000	14,000	12,400	AVERAGE LOAD KW. 12,625
Radojet steam press.	140	140	140	140	140	140	140	140	
Circ. water sup. temp.	52	52	52	52	52	52	52	52	MARTIN
Circ. water dis. temp.	60	63	63	64	63	63	63	63	
Condensate temp.	84	93	96	97	96	95	94	95	ENGINEER
Westinghouse oil temp.	110	110	112	110	112	112	112	112	KLEIN

FIG. 6 LOG OF ONE SHIFT ON 12,500 KW. TURBO-GENERATOR

of an instrument board on which the following meters and recorders are located:

Steam line pressure
Total flow of steam
Steam temperature
Blast furnace gas pressure
Draft recorders
Speed of coal feeder
Air pressure on coal feeder
Damper position recorders
Furnace and stack temperature recorders
Escaping gas temperatures
CO_2 recorders

The instruments on this board are mostly of Bailey manufacture. They are watched by the chief of the boiler room force, who also periodically inspects the instruments on the individual boilers and the logs taken by the attendants. In this manner steam generation is at all times under immediate and complete control and the minor adjustments which are necessary to maintain maximum operating efficiency are made at once.

The ultimate boiler installation will be capable of evaporating 780,000 gal. of water every 24 hr. Tests have shown that the present installation utilizes 85 to 90 per cent of the total available heat in the combined fuels. The contemplated installation of hollow heat-insulating walls, apparatus to pre-heat air entering the furnaces, and the introduction of water screens into the ash pits to prevent ashes and slag from caking, will raise this overall efficiency to probably 95 per cent. These are now being installed in No. 2 boiler for trial. If they prove satisfactory, all boilers will be similarly equipped. Their use, it is estimated, will enable the boilers to be operated at 400 per cent rating.

Hot water heat is used in the River Rouge foundry and in other manufacturing buildings. The boiler plant supplies steam to heat this water, as this has proved the most economical method of operation. Small quantities of steam are also furnished to the cement plant, although the latter has its own waste heat installation for the generation of most of the steam it requires.

Table 1 gives the principal data on the new type of equipment. Fig. 6 shows a log of readings on one of the original 12,500 kw. turbo-generators.

(To be continued in the November issue.)

TABLE 1. DATA ON NEW 62,500 HP. TURBO-GENERATORS AND AUXILIARIES

Units now installed	3
Under construction	3
Total units in complete installation	8
Capacity of each unit, hp.	62,500
Capacity, total, hp.	500,000
Steam pressure, lb.	250
Steam temperature, deg. fahr.	650
Superheat, deg. fahr.	250
Voltage	13,200
Revolutions per min.	1,200
Turbine sizes:	
Length (23 ft. C. L. to C. L. bearings), overall, ft.	29
Width, ft.	20½
Exhaust housing, radius	8 ft. 9 in.
Stages	15
Wheels	19
Longest blades, in. (26¼ total length)	23½
Mean diameter of blades, in.	108
Generator sizes:	
Length (17 ft. 8 in. C. L. to C. L. bearings), overall	21 ft. 7½ in.
Width, ft.	12
Height, ft (12 ft. diameter)	9
Condenser sizes:	
Shell inside diameter, ft.	14
Shell length, ft.	22
Exhaust inlet diameter, ft	11
Hot well diameter, ft.	4
Brass tube diameter, in.	1
Number of tubes	8,144
Total length of tubes, miles	34
Total condensing surface, sq. ft.	47,500
Complete condenser unit:	
Length, ft.	30
Height, basement floor to turbine floor, ft.	29
Center to center of condensers, ft.	24
Weights:	
Generator, lb.	107,000
Turbine rotor, lb.	107,000
Exhaust housing alone, lb.	127,000
Turbine housing, complete, lb.	325,000
Condenser shell (cast in one piece), lb.	142,000
Condenser complete, empty, lb.	330,000
Condenser unit, complete, lb.	400,000
Condensate pumps:	
Number per unit	2
(One is motor-driven and one turbine-driven. One in operation is sufficient for normal conditions.)	
Capacity of each, gal. per min.	1,000
Horsepower of each	50
Circulating pumps:	
Number per unit	2
(See note under condensate pumps, above.)	
Capacity of each, gal. per min.	30,000
Horsepower of each	600
Air ejectors, number per unit	2
Exciters:	
Total number	5
(One for every two units, and one spare.)	
Capacity of each, kw.	500

Better Management Pays in Textiles

Big Savings Made by Better Production and Sales Methods

By SANFORD E. THOMPSON and WILLARD E. FREELAND

President, The Thompson and Lichtner Co., Inc., Engineers

Assistant Professor of Marketing, Massachusetts Institute of Technology

TEXTILE plants require exceptional standardization and control of materials, methods and conditions if conducted profitably. Control of temperature and humidity is essential. The speeds of machines are an important factor in the processing. Material handling is receiving much study. The investment in equipment is so large that idleness and breakdowns of machinery must be ever guarded against. The questions of labor relations and wages are constantly furnishing headlines for the daily press. The industry suffers largely from the evils of nonresident ownership and the retention of a strictly military form of organization. In other words, it is a very complex industry with large and persistent problems.

The problems of management do not lie wholly within the mills. In large measure, products are made to special order, for making to stock involves forecasting demand in a market which is greatly disturbed by the style factor as well as by strong price competition. An increasingly large part of the fabrics of commerce go to the cutting-up trade, which is so little organized that it is difficult to foretell its activities. Branding as a measure of protection is not readily applicable in the textile field, although a few mills have succeeded in doing so.

Raw material forms a large portion of the costs of textiles. Natural products like textile fibers follow but slowly the economic law of supply and demand. The study of available supply and future prices of materials is a vital part of the purchasing program. With so strong a speculative element in buying one finds much gambling in raw materials. The evil is that success in this all too often covers up the losses made by poor methods in the mills. The type of cost accounting which separates the profit made in purchasing from the profit made in manufacturing is almost nonexistent in the textile business.

Vital Factors in Textile Management

Machine development is so important as frequently to overshadow operation and handling of labor. These factors involve general executive organization; relation of sales to production; control of work through the plant; planning of the work in each department to maintain continuity; perfecting of equipment; equalization of machine speeds; maintenance of machines and equipment to insure constant operation; process research involving not only the major treatment of materials but the multitude of process details; standardization of production methods with establishment of well-defined time standards; adjustment of incentives through detail job analysis and time study to equalize pay for equal effort and extend the scope of work on incentive basis; quality standardization with the means for interesting the employers in quality maintenance; development of cost accounting adapted to the particular plant; expansion of research activities with regard to engaging, discharging and training employees.

The following illustrations show how a few of the things have been treated effectively in various plants.

An Application of Management Methods

The following examples are drawn from work in a mill which is noted for good organization and its success in adopting progressive methods. This mill uses conveyors extensively and several of the references include changes in methods or processes affected by this method of handling.

The portion of the work described resulted in a labor saving of many thousands of dollars per year and made other savings, difficult to estimate, such as reducing waste, saving wear on belting, reducing the amount of new equipment required, and insuring greater efficiency and fuller use of present equipment.

Spinning Room—Warp. Changes were made so that two warp doffing crews did the work formerly requiring three crews. Rearrangement of the warp yarn and roving men's work eliminated one third of the men. Warp boxes were increased in size, reducing by one third the number of boxes handled. The number of conveyor stations necessary to supply roving in the warp spinning was found to be five instead of the nine in use. Remote control was furnished for the incline returning warp boxes and this operation greatly facilitated. It was found practical to lower the roving trucks to get the proper grade of roving station tracks and to insure proper results in the method of receiving roving from them and thus to avoid shortening the tracks from three-box lengths to two. All of these things were accomplished by research analysis aided by time study.

Spinning Room—Filling. With the aid of a properly designed table, the number of women on bobbin cleaning was cut in half. After the picking up of

bobbins in the weave room had been scheduled, a similar reduction was made in number of men taking care of returned filling. The method of winding down filling frames preparatory to doffing was arranged to give a minimum amount of waste to be pulled off by the battery girls. This was accomplished by team work of each pair of spinners. Several minor but important corrections were made in equipment, such as correcting the traverse of the belt shippers, which were causing belt slippage, and stiffening creels on the spinning frames to prevent shaking off the roving which was piled on them.

Investigation of the doffing crews brought out the fact that the number of spinners could be reduced one half, their places being taken by an equal number of doffers at a lower wage. More important was the gain in production of 2.5 per cent, an even flow of yarn, and a further gain due to fuller bobbins.

Weave Room. A study of the picking up of bobbins from the loom cans resulted in reducing the size of the crew while permitting one of these men to assist in picking up cloth from the loom. Another investigation resulted in setting up a standard table of loom beam requirements, eliminating one size of beam.

Dressing Room. An analysis of the work of the yarn men in the spooling section of the dressing room brought about a rearrangement that cut out one man.

Card Room. By an adjustment of roving trucks, the number of men operating the lift was reduced. A method of blowing the flat strippings in rolls and fly from cards had been given up as impracticable. This was given further study and a greater draft was obtained. With this it was found practicable to blow all waste to a picker house. Study was made of a seed machine treatment of fly waste and finally a fly was obtained which was found to be more uniformly clear of seeds, leaves, etc., than the fly picked over by hand and with a greater percentage of reclaimed cotton. To obviate the continual lack of balance between carding and spinning, tables were made up showing the proper number of roving frames required to produce the necessary roving for whatever spinning frames were running.

Six men on roving, banding and spindle oiling in the filling spinning were reduced to four. Two of these four men give their entire time to laying up roving, one of them being on hand at all times to look after the conveyor; the other two men taking care of the band work and spindle oiling. Previously, five of the six men laid up roving at irregular intervals, thus causing overloading of the conveyor at times when they were doing other work.

Sheeting Room. Changes in methods and operation of machines increased production 50 per cent with no increase in personnel and considerable reduction in overtime. This was effected by rearranging the room, changing the method of manipulating the folding machine, and improving the methods of handling and routing.

Filling Spinning, Doffing Plan. The doffing plan worked out was designed to have each spinner tend eight sides and have doffing crews doff sections of 24 frames, instead of the spinners tending and doffing four sides each. Under the old plan as determined by time study, the spinners' time was apportioned as follows: Doffing 28 per cent, sweeping 7.6 per cent, resting 32.4 per cent, tending frames 32 per cent. These figures do not include changing travelers, which is done on their own time, picking rolls, or weekly cleaning of the frames. Under the new plan, the doffing, sweeping, changing travelers, and weekly cleaning is eliminated from the spinners' work. Tending frames is doubled and the time apportionment is:

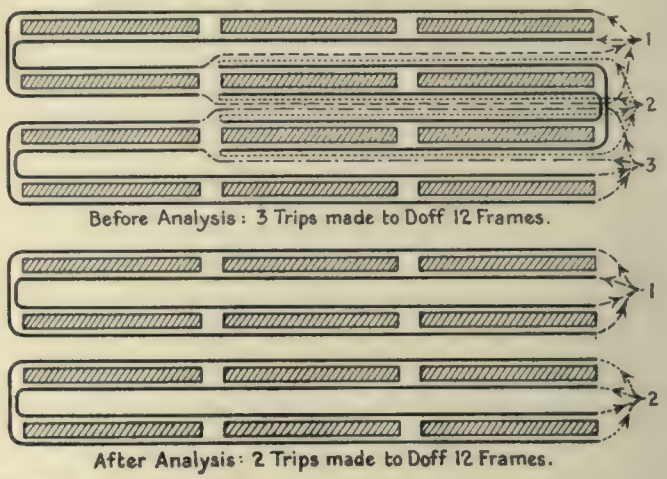


FIG. 1 EFFECT OF JOB ANALYSIS AND STANDARDIZATION ON LABOR AND COST OF DOFFING IN LARGE TEXTILE PLANT

Tending frames 64 per cent, and resting 36 per cent. The spinners pick only the front rolls, which takes 4 per cent of their rest time one day a week. Picking the two back rolls is done by one person for the whole filling section on a piece work basis.

Production Control in Another Mill

A system of general planning was inaugurated in this plant for the purpose of acquiring a master control over mill operations and close co-ordination with the sales office. The sales department originates manufacturing orders, calling for definite quantities of piece goods. Information is furnished to the sales department so that orders can be placed in such quantities as will require a whole number of sets of warps to be dressed.

Manufacturing orders are placed as follows:

1. The year is divided into three periods of four months each.

2. The sales department is notified by the mill of the date on which orders for the following period must be submitted in order that the mill may be able to start the new period with the correct loom layout and with sufficient warps on hand.

3. The sales department arranges to submit its orders to the mill in time so that all adjustments and corrections necessary can be made before the final date set.

4. These orders provide as nearly as possible for the total output of the mill for the period, careful attention being paid to economical production layout.

5. Records are kept at the mill and in the sales de-

partment of the status of each manufacturing order, and periodical reports are furnished by the mill, showing the condition of each order, including the amount in process.

6. The submission of manufacturing orders each four months enables the sales department to take advantage of the developments in the market. The manufacturing orders for the first period are necessarily based largely on estimated sales. By the time that orders for the second period are required, in normal years enough goods will have been sold so that these orders will be based on actual sales.

The advantages accruing from the adoption of this plan are:

1. The amount of goods of each grade manufactured is controlled by the sales department so that it knows ahead of time exactly how much must be sold.

2. Responsibility for ordering is definitely put up to the sales department, which, by reason of its close touch with market conditions, is best fitted to bear it.

3. The number of loom changes is reduced considerably.

4. Pressure is brought to bear to have the new patterns for the ensuing year adopted in time so that orders for the new goods can be placed promptly, thus avoiding an overrun on the old line.

5. The manufacturing orders and the various reports are all based on the same unit, so that the mill and the sales offices all "talk the same language."

6. A record of the work in process and a progress

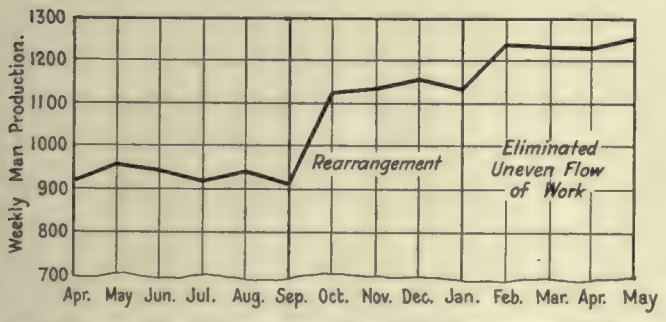


FIG. 2 INCREASE IN PRODUCTION THROUGH SCIENTIFIC ANALYSIS
Involving a change in detail methods in a large department of a textile plant. Number of operatives in department was reduced 12½ per cent.

report on each manufacturing order are provided for both mill and sales department.

7. A study or review of market conditions and demand as compared with output is required at least three times a year.

Detailed Planning in Mill

Manufacturing orders from the sales department covering the requirements for the period following are received by the planning department and sorted according to the width and kind of loom required. The planning department compares the production thus called for with the most economical layout, and the results of this comparison together with the orders are scrutinized by the mill superintendent.

Changes and adjustments which may be necessary from a manufacturing standpoint are entered on each manufacturing order, and these are returned to the sales department. Corrected orders, after checking and approval by the sales department and company executives, are returned to the mill planning department. Quantities called for on each manufacturing order are entered on the balance of stock record, and the orders are then filed by serial number in a special binder.

Instructions to the mill are issued by the planning department in the form of mill orders, of which four copies are made. The total amount ordered on the mill may be less than the amount on the manufacturing order if whole sets of warps are required. The mill orders are approved by the mill superintendent and distributed in time to give ample notice to the dress room of the warps that will be required. The four copies of the mill order are distributed one each to the boss dresser, foreman of the weave room, superintendent's office and planning department. Before distribution, the mill order is routed to the balance-of-stock clerk, who makes the necessary entries on the balance-of-stock record and initials the order to indicate that it has been entered. The dress room makes a daily report to the planning department, showing the number of sets, beams, and cuts dressed each day.

Balance-of-Stock Record at Mill

The balance-of-stock record is an important element in the planning work. Its main operations are briefly described thus:

Manufacturing orders are added to the Applied to Order column and subtracted from the Available column. Mill orders are added to the Ordered column and the Available column. The warps reported as finished by the dress room are added to the Warped column and deducted from the Ordered in Mill column. A special procedure is necessary in case of interchangeable warps which are recorded on a master sheet under the common, or key, symbol covering this common grade of warps. When a Report of Goods Invoiced is received from the cloth room office, the quantity is subtracted from the Warped column and also from the Applied to Order column. Seconds and rejections are handled on the balance-of-stores record in the same way as goods invoiced.

The weave room foremen fill out a daily report showing all changes of warps running on looms in their departments and send these reports to the planning department before 9 A. M. on the day following. This report shows the date, loom number, warp taken off and grade symbol, warp put on and grade symbol, number of cuts in warp put on. The loom record is set up on visible index equipment. A salmon colored guide card is prepared for each grade of goods manufactured, having the symbol of the grade and also the word "running" in the center of the card. A similar set of blue guide cards is prepared for each grade with the word "inactive" in the center of card. These cards are sorted alphabetically and numerically and arranged on racks with the blue following the salmon. A buff colored card is made out for each

loom. The system was started by obtaining a report showing the grade on which each loom was operating and the cards for the looms in operation were filed under the proper grade card of salmon color bearing the word "running." The cards of the looms not in operation were filed in the same manner under the proper blue "inactive" card. In the maintenance of the loom record, the reports of warps on and off are entered on the corresponding loom card and these are re-filed in the proper position. The loom cards show the dates of warps on and off.

In a spinning room running a large number of yarn sizes on different frames and requiring frequent change in yarn size on the individual frames or sides, planning the work is of great importance. In one case the work of the doffing crews was studied in detail. Inexperienced doffers were put on in pairs, a pair replacing one experienced doffer, and the two best doffers were placed at the ends of the frames to start and stop the machine. Special methods of procedure were worked out for handling the yarn trucks and special trucks were designed to expedite the work. The problem of scheduling doffer crews to the frames could then be worked out. The usual plan in doffing is to assign a doffing crew to a certain number of sides and for a spinner to raise a flag and yell when a frame runs out. This occasions frequent idle time. To avoid this the yarn sizes were carefully planned on the frames. The doffing squad was required to doff by a definite schedule. Clocks with special indicators showed the time for the next doff. Sides stopped for any reason were put into line as quickly as possible. As a result of this development, along with an incentive to the doffer for following directions, the number of doffers was decreased about 15 per cent, the number of men handling trucks was cut nearly in half, the quantity of yarn on a bobbin was increased, output of spinning frames was increased 4 per cent, and a saving of several thousand dollars per year in each spinning room resulted.

The system of cost control installed in one large knitting mill is based on the uniform cost system of the hosiery industry, which has been adapted to tie in closely with scientific production control and with the general books. The benefits obtained are:

1. Losses anywhere from 1.5 to 20 per cent were shown in 27 per cent of the styles. One style alone, using 1923 volume of sales, showed a loss of over $15,000. Naturally, like most unprofitable items, this style was one of the larger sellers.

2. The company has discontinued making those lines which showed a loss and is jobbing them. A conservative estimate of saving is $20,000. Equipment is thus released to manufacture profitable lines, and this concentration tends to decrease the cost of manufacture.

3. Through cost records, the fact was discovered that it was cheaper to sell as waste certain classes of defective hosiery than to send them through to be sold as "seconds" or "thirds."

4. Department expense is controlled through comparative monthly statements and a monthly profit and loss statement is prepared in place of the former semi-annual statement.

5. Through the costing of sales, the sales department can determine the relative profits various salesmen are making for the company. The cost records also facilitate correct pricing of inventories.

Management Methods in Hosiery Mill

Besides the cost control system outlined above, several other problems involving management methods in the same mill were studied and improved. The larger problems were the introduction of a system of planning and control to bring about better co-ordination of the work of the sales and production divisions, standardization of methods, and determination of wage incentives.

The situation before control was established was the quite familiar one of some thousands of dozens of stockings on back order with perhaps over eight times that quantity of gray stock on hand, but not available for these particular orders because of the lack of classification of incoming orders and the absence of a scientific planning system. Planning and production control is under a production department, with which has been combined the pay-roll, cost, and methods departments, with resulting co-ordination of their work and a degree of supervision not previously obtainable.

Some results of the work have been:

1. A 10 per cent reduction was made of finished goods in warehouse without impairing the delivery service. This also brought about a needed relief from congestion in the warehouse.

2. A reduction of 34 per cent was made in the gray stock. This was due to proper planning of the balances of the gray stock so as to permit better distribution by styles and sizes.

3. Practices were improved and waste eliminated by the standardization of the methods of handling and the follow-up of batches from gray stock.

4. Considerable savings were made in the handling of re-boards, re-dyes and seconds, and the quantities of these to be handled were reduced.

5. The system of control has eliminated congestion of work in the dye house and at key operations by close scheduling and follow-up. Records have been established so that the management knows at all times the progress of all work. This has also brought about better planning of labor requirements and better classifying and grouping of labor.

6. Stores of supplies have been centralized and control established, which assures virtually complete elimination of delays due to missing supplies or machine parts.

7. Sales and manufacturing information has been put on Hollerith cards and standard procedures established so that prompt and accurate reports and analyses are available for the management and the production office. Idle machine time records on these cards have resulted in studies reducing this form of waste.

8. Control of the maintenance department has been gained by the preparation of instructions, and proper scheduling and follow-up.

9. Careful job analysis of manufacturing problems and methods has been made, establishing accurate inventories by standardizing methods and conditions.

Manufacturing Procedure Simplified

A Complete Cycle of Orders and Returns for Both Shop and Office Functions

By JOHN R. BANGS

Instructor of Industrial Engineering, Cornell University

THE first part of this article[1] showed in diagram form the complete manufacturing cycle, beginning with the sales order and tracing all the steps down to the workman on a particular machine or performing a particular operation. It also traced the sequence of the forms used and showed, with explanation of origin and use, the sales order, route sheet, and balance-of-stores sheet.

THE CORNELL TRANSMISSION CO.
Ithaca, N. Y. U. S. A.
PURCHASE ORDER

TO *Central Casting Works*
Geneva, N. Y.

No. *C-827*
DATE *Apr. 14, 1925*

PLEASE FURNISH THE FOLLOWING, VIA *Truck*

DATE TO SHIP	QUANTITY	DESCRIPTION	SYMBOL	SHIPPING WEIGHT	UNIT PRICE	AMOUNT
Apr. 20	*2500*	*Idler Gear Blank, 3½ per cent Nickel Steel*	*G-3*	*1800*	*.27*	*675.00*
Apr. 20	*2500*	*Countershaft Drive Gear Blank, 3½ per cent Nickel Steel*	*G-1*	*2300*	*.38*	*950.00*
F. O. B. *Ithaca*		TERMS *2-10 net 60, March 1.*		*4100*		*1625.00*

COPIES TO: COST DEP'T, BALANCE OF STORES CLERK, STORES DEP'T, RECEIVING DEP'T

CONDITIONS:
1. Acknowledge receipt of this order by return mail advising if shipment will be made on dates requested. The right is reserved to cancel all or any part of this order if not shipped within the time specified.
2. All material furnished must conform with our specifications where indicated. If found not in accordance, shipment will be rejected and held at your risk awaiting disposition. Shipper must pay all transportation charges, both ways, on all rejected material.
3. Separate invoice for each order must be mailed on day of shipment with signed Bills of Lading showing full routing.
4. We will not be responsible for goods delivered except on a properly authorized Purchase Order.

OUR PURCHASE ORDER NUMBER MUST SHOW ON YOUR PACKAGE, PACKAGE SLIP, BILL OF LADING AND INVOICE.
INCLUDE PACKING SLIP IN EACH SEPARATE CONTAINER.
RENDER ALL INVOICES IN DUPLICATE.

THE CORNELL TRANSMISSION CO.
BY *J. O. Jeffrey*
Purchasing Agent.

FIG. 6 PURCHASE ORDER (ACTUAL SIZE 8½ IN. x 11 IN.)

Taking up the manufacturing procedure from this point, the first form to consider is the purchase order (Fig. 6), issued from a purchasing department requisition, made out when available stock falls below the minimum.

The purchasing order is then sent by the purchasing department to the vendor for the purchase of this material, a duplicate copy going to the balance-of-stores clerk. When the material issue is returned to the route clerk, he clips it with the other orders, and forwards it to the time-study department, where the necessary time studies are made, instruction cards written, and rates set on the bonus time cards. These forms (Figs. 3 to 11) are then passed on to the order-of-work clerk, who encloses them in a route file which consists of all the route sheets bound together with a series of envelopes to contain the work orders, move orders, etc. These envelopes are known as job envelopes and the route of the part is printed on the front.

At this point the reader will naturally try to visualize the relation of all these written instructions. When is a route sheet written? What is a work order? How are they related to the instruction card? These are natural questions. They are readily made clear by Fig. 2.[2] It is a sort of family tree beginning with the sales order, and going through all the stages down to the specific instructions on the instruction card, Fig. 11.[3] The representative set of forms, Figs. 3 to 11, which illustrate this article, were designed with the two diagrams, Figs. 1 and 2, as a background, and they have proved of immense value to both student and instructor. The design of such forms is required of all industrial seniors at Cornell, this particular set being the work of J. O. Jeffrey.

Beginning with the sales order (see Figs. 2 and 3) we can trace these forms through the family tree. Production and shipping orders follow in normal sequence as copies of the essentials of the sales order, some items being omitted and others added, as, for instance, the price which appears on the sales order is usually omitted on the other orders. The manufacturing order, which is really a "local" type of order for use in the planning department only, will follow next in line, if the complexity of the production order demands it. There is considerable confusion in regard to nomenclature at this point because the term "manufacturing" is applied by many plants

[1] The preceding article appeared in MANAGEMENT IN MANUFACTURING, September 1925, pp. 149-152.

[2] Figs. 1 to 5 appeared in the September issue.

[3] Fig. 11 is an instruction card taken from practice, at the Gleason Works, Rochester, N. Y.

to the production order or the work order.

In logical sequence we have the breaking down of the production orders or the manufacturing orders, if such are in use, into route sheets, Fig. 4, one for each part of the product. And further there follows another breaking down, the writing of the work orders. There should be a work order made out for each "stop"

WORK ORDER

PART NAME *Idler gear* No. *A-25*

SYMBOL *G-3* CHARGE TO *E-183*

OPERATION *Bore and face first side*

OPERATOR No.	*437*	ALTERNATE	*436*
MACHINE No.	*J-6*	ALTERNATE	*J-7*
QUANTITY	*360*	DATE ISSUED	*Apr. 13, 1925*
DRAWING No.	*G-43*	TO BE COMPLETE	*Apr. 17, 1925*
PATTERN No.	——	COMPLETED	*Apr. 16, 1925*

REMARKS

FIG. 7 WORK ORDER (ACTUAL SIZE 4 IN. x 4¾ IN.)

(machine, bench, or department) on the route sheet. Its information would be in the form of an "order" or command such as "Bore and face first side" in Fig. 7. Naturally such an order, to be adequately performed with a standard set time as determined by the time-study man and appearing on the bonus time card, Fig. 9, must be supplemented by detailed instructions. Consequently an instruction card, Fig. 11, showing speed, feeds, tool layout and standard time for the job is essential both to the workman and the management. Note, then, that there should be an instruction card for every work order, i.e., for every entry on the route sheet.

Inspection and Move Orders

Inspection orders, move orders and equipment move orders are also written for each "stop" on the route sheet where their use is required.

The inspection order, Fig. 10, which is sent to the inspection department, usually tells what inspection is to be made and also serves as a report. In some cases the inspection department may write an inspection card (see Fig. 1) and this will carry the report of the inspection at the machine. Such variations as this will depend on the nature of the product and the organization of the inspection department. With this discussion and with Fig. 2 in the mind's eye we can proceed.

The order-of-work clerk has charge of the planning board and correlates the departmental dispatch boards with it. When he receives the route file for a given production or manufacturing order, he retains the route sheet, and assigns each operation to be performed to the machine or production center for which it has been routed, by removing the duplicate work orders pertaining to this operation, and placing them on the planning board on the hooks or in the pockets controlling this particular machine. The duplicate work orders are placed on corresponding hooks or in pockets on the departmental dispatch board which control the machine or process to which the work is assigned. He does this for each operation for which the route file contains instructions, placing the work orders and related documents in the sequence called for by the scheduled time of performance. This results in the distribution of the contents of the route, i.e., the job envelopes, thus making the planning board the mirror of the whole shop, each dispatch clerk having that

MATERIAL ISSUE

DATE *Apr. 13, 1925.* No. *A-25*

MADE OUT BY *J. P. Wood* CHARGE TO *E-183*

QUANTITY	DESCRIPTION	SYMBOL	UNIT COST	AMOUNT
360	*Idler Gear*	*G-3*	*.27*	*97.20*

ISSUED, *Apr. 14, 1925.* (Date) *A. R. Purdy.* (Storekeeper)

DELIVER TO *M. E. Berg* DEP'T *G* SPACE *6*

RECEIVED *4-14-25* (Date) *M. E. Berg* (Name)

INITIAL, AFTER MAKING PROPER ENTRY:

BALANCE OF STORES CLERK, 1 *C. L. J.*, 2 *C. L. J.*

ENTERED ON BIN TAG, *A. R. P.*

ENTERED BY COST CLERK *J. C. N.*

FIG. 8 MATERIAL ISSUE (ACTUAL SIZE 4 IN. x 5½ IN.)

portion of the route file that pertains to his machines.

Let us assume that the first of these machines we are considering is a Jones and Lamson flat turret lathe no. 50, as shown in Fig. 1, and let us assume further that there is plenty of work ahead so that this particular work order is placed in the proper sequence in the upper or "Jobs-ahead" pocket. In due process of time it will be advanced to the second or "Next-

job'' pocket, corresponding changes having been made by the order-of-work clerk on the planning board.

When the work order has been advanced to the next-job position the dispatch clerk opens the job envelope and gives the move man the material issue, if material is to be drawn from stores, and the identification tags that are to be fastened to the work. The move man with this authority draws the material from stores, signs the issue, and moves the material, suitably tagged and

BONUS TIME CARD

PART NAME *Idler Gear* No. *A-25*

SYMBOL *G-3* CHARGE TO *E-183*

OPERATION *Bore and face first side*

OPERATOR No. *437* NAME *A. R. Hill*

MACHINE No. *J-6* ISSUED *Apr. 13, 1925*

DRAWING No. *G-43* RETURNED *Apr. 17, 1925*

6	APR. 16 6.4	STOP	6.4	REMARKS: 3 rejected due to bad material.
5	APR. 16 0.0	START		
4	APR. 15 8.5	STOP	8.5	F Cross if not finished
3	APR. 15 0.0	START		NF Cross, if finished
2	APR. 14 8.5	STOP	4.9	STARTED 360
1	APR. 14 3.6	START		SPOILED 1 — B. F. T. Inspector

NOTE: If actual time per piece is equal to, or less than St'd Time, compute Pay on Bonus Plan; if greater than St'd, use Day Rate.

TIME NO. PIECES TIME PER PIECE
19.8 × 60 ÷ 359 = 3.31

OPERATOR'S RATE	NO. OF PIECES	ST'D TIME	PAY (BONUS PLAN)
.65 ×	359 ×	3.5/60 × 1.20 =	16.34

TIME	PAY (DAY RATE)
19.8 × =	

MACHINE RATE	OVERHEAD
1.10 × =	21.80

PAYROLL: A. T. B. ROUTE CHART: M. C. M. M. E. Berg. Gang Boss

FIG. 9 BONUS TIME CARD (ACTUAL SIZE 4 IN. x 6¾ IN.)

identified, to the machine where it is required. The stores clerk, upon delivering the material, corrects his bin tag, and forwards the material issue to the balance-of-stores clerk, who subtracts the material from the On Hand and Apportioned columns, Fig. 5, prices it, and sends it to the cost department, where it is charged against the cost of the production order. If the material is not to be drawn from stores, but is to be moved from some other machine, the same procedure is involved, the authority being the move order. The dispatch clerk next issues the equipment order to the move man, who procures all special tools, jigs and fixtures and brings them to the machine in advance of the time scheduled for the operations to commence.

Upon completion of the job in process, the operator of machine no. 50 takes his operation order, bonus time cards and instruction card to the dispatch station and returns them to the dispatch clerk, who stamps the time upon the time card. The dispatch clerk now takes the dispatch documents pertaining to the work just completed from the job-in-process pocket and advances the orders of the job next in order to the job-in-process pocket. He stamps the time upon the time card, and gives it to the workman with the work order, instruction card, etc., for the new operation. The workman then returns to the machine, and starts the new operation for which complete preparation has been made. The dispatch clerk also issues the new inspection orders to the inspector. The move man takes the work just completed on machine no. 50 to the next machine listed upon the route chart, and returns the tools, jigs or fixtures to storage. The dispatch clerk returns all work orders, drawings, lists, etc., to the order-of-work clerk, who checks the completed operation on the route chart, and returns the drawings, instruction cards, etc., to the proper departments.

The time cards are sent to the payroll, where they are first checked against the attendance board record,

INSPECTION ORDER

PART NAME *Idler Gear* No. *A-25*

SYMBOL *G-3* CHARGE TO *E-183*

OPERATION *Bore and face first side*

OPERATOR No. *437*

MACHINE No. *J-6*

NO. WANTED	NO. DELIVERED	NO. INSPECTED
350	360	360
PASSED	REJECTED	RETURNED
356	4	0

REJECTED: BAD MATERIAL 3; BAD TOOLS 0; BAD WORK 1

REMARKS

B. F. Titus, Inspector

FIG. 10 INSPECTION ORDER (ACTUAL SIZE 4 IN. x 6¼ IN.)

or time clock record and then used for making up the payroll. The bonus or job time cards are then forwarded to the cost department, where with the material issues they are used to compile the cost of the product.

This scheme was devised to teach the fundamentals of manufacturing. It represents no particular sys-

INSTRUCTION SHEET No.

PART NAME *Spur Gear (American La. Fr. Fire Eng. Co.)* PART No. *2R 302*

OPERATION NAME *Turn O.D. Both Sides of Face & One Side of Web.* OP. No. *5*

DEPT. *11* MACH. CLASS *57* MACHS. *Libby*

MADE BY *W. C.* APPROVED BY *D. V.* DATE *8-1-24* MAT'L *SAE 2320*

NO.	OPERATIONS	TOOLS-JIGS, ETC.	CUT SPEED R. P. M.	CUT SPEED FT./ MIN.	INCHES FEED PER. REV.	INCHES FEED SETTING	TIME	
	TOOL LAY-OUT							
	SET-UP TIME							
	PROCEDURE							
1	*Chuck blank, start mach. and set stop, advance and set carriage*							*97*
2	*Index and advance turret. Feed*							*41*
3	*ROUGH O. D.*	*A–¾" Sp. Stellite*	*23*	*80*	*.0104*	*96*	*9*	*30*
4	*ROUGH TWO SIDES*	*B–Two ¾" Tools*	*23*	*80*				
5	*Change speed and feed*							*08*
6	*ROUGH WEB*	*E–Form Tool Spec.*	*13*	*38*	*.008*	*128*	*1*	*25*
7	*Back index and advance turret. Change speed and feed. Throw in feed*							*60*
8	*FINISH O. D.*	*C–¾" Tool*	*60*	*210*	*.0104*	*96*	*4*	*30*
9	*FINISH SIDES*	*D–Two ¾" Tools*	*60*	*210*	*.0104*	*96*		
10	*Change speed*							*06*
11	*FINISH WEB*	*F–Form Tool Spec.*	*8*	*24*	*.0104*	*96*		*50*
12	*Stop mach. and back turret*							*14*
13	*Back tool-post carriage and index tool-post. Advance carriage and start mach. Change speed*							*56*
14	*ROUND O. D.*	*G–¾" Flat Tool*	*23*	*80*	*H and*			*35*
15	*Advance tool-post*							*08*
16	*ROUND INSIDE of RIM*	*G*	*23*	*67*	*H and*			*30*
17	*Back carriage and remove blank*							*72*
	Note—Back and index tool-post for #10 during #9. Advance carriage and set, and throw in feed for #10 during #3.							
	BASE TIME for 1 piece						*20*	*.12*
	Allowance 5%						*1*	*.01*
	TIME for 1 piece						*21*	*13*

FIG. 11 INSTRUCTION SHEET (ACTUAL SIZE 8½ IN. x 11 IN.)

tem, but we believe the modifications of such a scheme are numerous, and by the expansion, consolidation and elimination of certain stages, systems may be devised to meet an endless number of manufacturing conditions. This involves no unusual amount of trouble, as every system yet devised has required special adaptation in its applications.

Limitations of Systems

Many companies today shy, and rightfully so, at the Taylor system and its principles because thousands of dollars have been expended in many plants on a mass of red tape, by people who have failed to realize the limitations of these things when applied to a particular plant and product. One of the most recent to recognize and to eliminate a large percentage of overhead so incurred is Ralph E. Flanders, manager of the Jones and Lamson Machine Company. His paper[4] on the reorganization of his plant should be a lesson to all persons teaching and practicing industrial engineering, because it shows the modifications that must be made when profits drop off. Managers throughout the country have learned and recognized these limitations and have made modifications suited to the best interest of their plants.

[4] "Design, Manufacture and Production Control of a Standard Machine." Presented to the American Society of Mechanical Engineers, Dec. 1, 1924.

Standard Electrical Markings

THE approval as American standard of a system of connections and markings for electric power apparatus is announced by the American Engineering Standards Committee. The standard is the result of a revision of the work of the Electric Power Club which has been developed over a period of years. The most important part of the revision, which has been carried out by a sectional committee upon which all interested bodies are represented, under the sponsorship of the Power Club, has consisted in systematizing the work into a general plan which not only takes care of present needs, but also provides flexibility for developments.

Previously, great confusion existed, as each manufacturer was using his own markings. The system as now elaborated assigns a characteristic letter to each type of connection. Sub-numbers are used to differentiate between the various terminals of each class. These letters were chosen wherever possible so as to conform to the practice of many years and cause as little confusion as possible for those who have to make practical use of the diagrams presented.

The fundamental scheme is very simple, and completely covered on a single page. The remainder of the standard illustrates the methods of applying such markings to the more commonly used types of apparatus. These key diagrams are intended primarily for the use of engineers and draftsmen in correctly placing the required marking on the working diagrams of connections or wiring and for the use of engineers and wiremen installing the apparatus. Some illustrations of actual working diagrams are given to show how these markings are used commercially.

As only a relatively small part of the alphabet has been used, enough letters remain to cover any new varieties of apparatus that may be developed.

This standard represents the combined effort of a large number of engineers, and has stood the test of several years' practical application on a large scale.

Aroused Executive Interest Aids Effective Production Control

Management in Southern Furniture Plants

By CHARLES F. SCRIBNER

Management Engineer

PRODUCTION control methods which are successful in a plant with from 500 to 1000 workers are one thing. When such methods are transplanted to plants with from 150 to 500 workers, many changes have to be made before they work successfully and with profit.

While the basic principles remain the same, the mechanism by which these principles are applied has to be adapted to the needs of the smaller plant and the smaller organization. Failure to give this fact due consideration has resulted in costly mistakes in the past.

In manufacturing furniture, as in all wood-working industries, there are certain peculiar conditions to which attention must be given when planning production control methods, if these methods are going to assist the management toward more economical operation and are to have a permanent place in the organization where they are introduced. When they are not so considered, the manager soon reaches a point where he says: "Throw the whole thing out; we will go back to our old methods."

In the greatest number of furniture plants the method by which the production is controlled centers around the superintendent's office. General orders reach him from time to time, without any specific date as to when they are to be completed. He is left to make his own plans and schedules and too often must carry all the details in his mind. When the stock of any one product is depleted to a point where shipments cannot be made promptly, he is taken to task and a "rush order" is assigned to the lagging article. In the course of a short time about 60 per cent of the work in process will have become rush orders and the superintendent does not know which way to turn. Where such a state of affairs has existed for a number of years, the manager, superintendent and the foremen gladly welcome any methods which will give relief.

Developing the Control Methods

To develop production control methods of practical value to the medium-sized furniture plant in the South it is found necessary to give consideration to the following factors:

1. There is a limited quantity of any one product which will be made at one time and on one order.
2. Individual parts will be processed very rapidly, with a high set-up time as compared to actual producing time.
3. Routing of individual parts must be in such sequence that lumber waste from larger components can be used in producing components of smaller dimension.
4. High quality of output means constant supervision on the part of the foreman, calling for methods which require a minimum of clerical effort to keep up to date.

After these factors are considered it will be found that practical methods must be built around the following:

1. Character of manufacturing is to be considered where repeat orders are issued at varying intervals, for a varying but limited quantity of any specific product.
2. Detailed planning and control of production must be carried out in individual departments, rather than in a central planning department located at some distance from the actual conditions.

Success in the introduction of production control methods is found to depend largely upon the co-operation of foremen and gang bosses in the several departments. If they feel that orders come to them from above and they have no part but to execute them, control methods will not secure their active support and real interest. There will then be no permanent benefit to the organization.

On the other hand, if the central planning department will limit its activity to preparing general schedules, analyzing and arranging for quick reference all available information concerning production details, much good is accomplished. Such general schedules and the necessary information must be placed in the foreman's office, to be used by a clerk under his general supervision. The foreman's interest is then aroused in making a better showing in his department, and his personal time and efforts are not given to clerical detail, for which he is temperamentally unfitted and against which he has the usual objections of the "practical" man.

Giving the foremen a clear understanding of the part they are to play in the operating methods adopted, is the first important step. Without such an understanding little good results. It is found that the best

way in which foremen can be made acquainted with new methods is through a series of weekly meetings, where a specific phase of the work is taken up at each meeting, a short description of the method given, then the meeting opened up for a round-table discussion, at which specific questions are asked and answered.

At a number of furniture plants the list of topics shown in Fig. 1 formed the basis for thus securing the foremen's co-operation. Stenographic notes were taken at each meeting and a copy of the details was furnished each foreman on the following day. Such meetings give to each foreman an opportunity to make clear the concept of each step toward better operating conditions, at the same time bringing to light certain conditions within his department which it is not within his power to control.

The average foreman becomes confused at times as to the interrelation of the various forms which are used to secure and record information. This has been made clear to him by attaching to a large board in the office a copy of each form, with lines, arrows and explanatory notes connecting up the same. A photostat copy of this layout, furnished each foreman and filed in his record binder, gives him detailed information which he can carefully study at his convenience and from which he can answer the greater part of the questions that come to his mind.

There is one feature which has been found important in securing profitable results from production control methods in southern furniture plants. This is that foremen must be given an opportunity for making promises as to when their departments will complete the work on a specific order. Such promises, however, are to be checked against the schedules of work already in process and the foremen then convinced that the dates they set can be anticipated. When foremen have had a part in setting the dates for completion of the work, they will be found pretty likely to live up to these dates, regardless of the extra effort it may require on their part.

Such a plan is also found an excellent means by which the foremen are trained to respect promises made; also to convince them that the management does not expect the impossible, but does expect them to measure up to the full responsibility of their positions.

Practical plans and means by which production control methods have produced most effective results in furniture manufacturing have been based upon the use of Gantt charts. These charts have been found simple to operate, easily understood by foremen and workers, and provide a means by which events are scheduled, followed up and definite records made.

These charts, of which the three essential ones are shown in Fig. 2, are:

A. General schedule and progress chart
B. Machine record chart
C. Department schedule and progress chart

The general schedule and progress chart is used in the planning department to record the promises which have been made by the foremen as to completion of any specific order in their departments. It makes no attempt to follow up the work from machine to machine

SERIES OF WEEKLY FOREMAN MEETINGS

SUBJECT	LEADER	TALK BY	TREATMENT	ILLUSTRATIONS
Organization and Executive Control	Industrial Engineer	General Manager	Explain necessity for organization. Illustrate actual use of standard instructions.	Organization chart Standard instructions on responsibilities
Master Schedules	Industrial Engineer	Factory Manager Sales Manager	Show why advance planning is necessary to factory. Explain how sales and manufacturing departments co-operate.	Master schedule for next six months
Purchasing	Factory Manager	Purchasing Agent Industrial Engineer	How the purchasing agent knows when materials are needed. How he gets them in time.	Purchase requisition Purchase order
Stores and Material Control	Factory Manager	Industrial Engineer Production Superintendent	The principles outlined by the industrial engineer. Application explained by example by production superintendent.	Balance of stores record
Production Control	Factory Manager	Production Superintendent Industrial Engineer	A manufacturing order carried through its entire handling.	Manufacturing order Department schedules Material requisition Job time card
Time Study and Standards	Production Superintendent	Time Study Man Industrial Engineer	Why time studies are essential. How their results help the foremen.	Time study record Decimal stop watch
Timekeeping and Payroll	Factory Manager	Payroll Clerk Cost Clerk	Need for accuracy in timekeeping. How checks to payroll are made and cost of carelessness.	Clock card Payroll analysis sheet
Idleness and Waste	Industrial Engineer	Factory Manager Production Superintendent Cost Clerk	What each foreman can do to reduce. What management can do. Net results.	Idleness record Waste percentages
Shipping and Traffic	Factory Manager	Shipping Clerk Industrial Engineer	Need for prompt shipments to satisfy trade. How shipping department can help in keeping promises.	Shipping orders Invoice
Selling and Distribution	Factory Manager	Sales Manager General Manager	Knowing the territory and getting business on quality and service. Promises kept an aid to more and better business.	Customer's order Sales records
Costs	Factory Manager	Cost Clerk Industrial Engineer	Explain why foremen are given certain information. How they can help reduce costs.	Cost record card Cost analysis sheets
General Accounting	Factory Manager	Treasurer Bookkeeper	The acid test of all that is done in the organization. The proof through final figures.	Ledger sheet General account distribution

FIG. 1 LIST OF TOPICS DISCUSSED AT WEEKLY FOREMEN'S MEETINGS

nor the progress of work on individual pieces. It forms the connecting link between the sales department and the load on the manufacturing end of the business, furnishing a means by which the sales department can make definite delivery promises to customers, that will be lived up to in practice.

The machine record chart, B, is kept in the foreman's office and a blueprint copy is furnished to the factory manager at the close of each week. This chart has been found of the greatest benefit in the machine

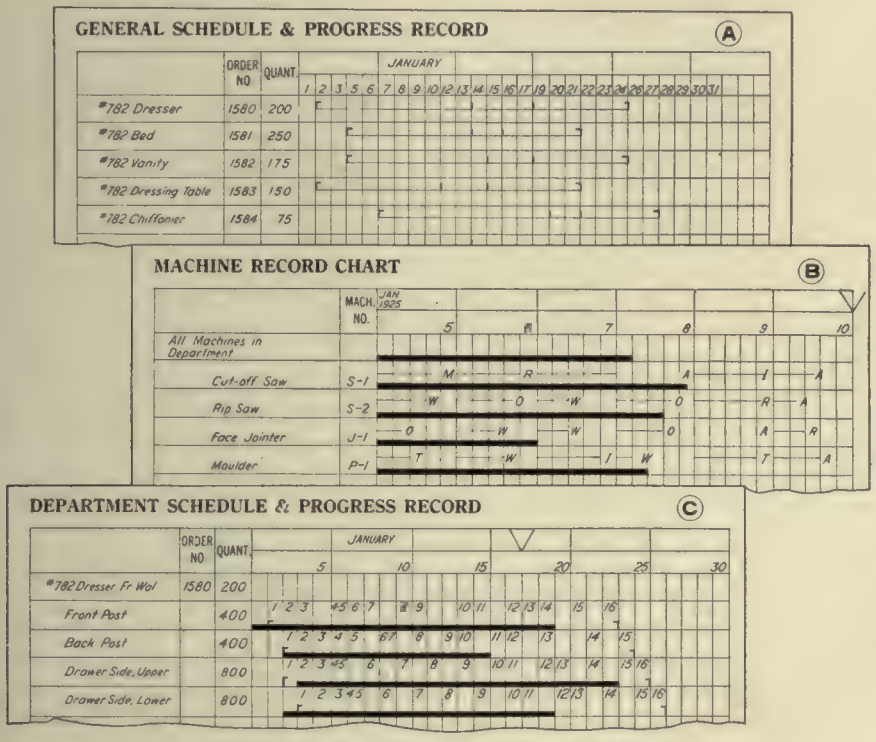


FIG. 2 THREE ESSENTIAL GANTT CHARTS

room, which, in the majority of furniture plants, is the department which controls plant output. Providing a weekly record of machine idleness and its causes, it acts as a spur to the sales department in selling the potential capacity of the plant, thereby spreading fixed charges over a greater volume and making it possible to keep selling prices at a minimum, while preserving the profit margin.

The department schedule and progress chart, C, is kept in the foreman's office and serves as the basis from which he follows up daily the progress of work in his department. It insures against failure of the promises which he has made.

Manufacturing Orders and Their Handling

When a lot of manufacturing orders are decided upon, promises of the various foremen, after they have been checked against the work in process, are recorded as shown on the general schedule and progress chart. The orders, of which there are three copies, are then distributed to the machine, cabinet and finishing departments.

Immediately upon receipt of an order the clerk in the machine department foreman's office refers to his construction record book and, from information recorded therein, makes out a route tag for each individual part which is needed to make the complete unit. On this tag the operations necessary to produce the piece are listed in their proper sequence. These route tags bear the same order number as the original manufacturing order, as no attempt is made to arrive at part costs.

The route tags are then filed in the foreman's office, ready to be issued for the first operation as they are needed to keep machines in operation or as the foreman plans his work. Before they are issued, however, they are scheduled on the department schedule and progress record, so that all parts which go to make a completed manufacturing order will be finished at the scheduled date and can be moved to the cabinet department on the date promised.

As the work progresses through each operation the job order time card is turned in to the clerk, from which he marks up the completion of the operation before sending this time card to the payroll clerk.

With final completion of all parts required for the order, the proper entries are made on the progress record and the original order, marked on its face, "Completed, Machine Dept. (and Date)" is then sent to the central planning department.

The same clerk records progress of the work in the machine, cabinet and finishing departments, following the procedure outlined above and returning necessary records to the planning department.

Scheduling Orders and Following Up

The purpose of the general schedule is to establish a starting and finishing date, not only for the order as a whole, but for the work done in each department.

It is from the department schedule and progress record that the foremen see at a glance where their departments stand each day with reference to what is expected from them. The construction record sheets furnish a permanent routing for each piece required as long as that product is produced. These sheets show the order in which the individual parts are to be produced, keeping in mind minimum machine changes and most effective use of materials, as well as amount of work required to produce each part and have all parts reach completion at about the same time.

These items of information are very important. A live, wide-awake and ambitious foreman will watch each point where his attention is required, without waiting for his superior to push him to his responsibilities.

A foreman who does not give attention to the weak

PHASE OF BUSINESS BENEFITED	CHARACTER OF BENEFITS
SALES DIVISION	(a) Definite promises for shipments made and kept. (b) Time from receipt to shipment of orders shortened. (c) Facilitates sales to meet potential plant capacity.
FINANCE DIVISION	(a) Department overhead rates are standardized. (b) Cost of plant idleness is measured. (c) Cost and general accounting plans are co-ordinated.
PRODUCTION DIVISION	(a) Material and supply inventories are regulated. (b) Standards take the place of guesswork and judgment. (c) Knowledge of condition of all orders in process insured at all times.
PURCHASING DEPARTMENT	(a) Orders are placed only for materials actually required. (b) Orders placed are followed up to insure prompt delivery. (c) Volume of purchases materially reduced for given volume of business.
INSPECTION DEPARTMENT	(a) Product produced is of uniformly higher grade. (b) Customer complaints reduced to a minimum. (c) Cost of inspection is kept at the lowest possible figure.
SHIPPING DEPARTMENT	(a) Planning shipments in advance is facilitated. (b) Amount of shipments per dollar of shipping cost is increased. (c) Steady employment for a minimum number of employees is insured.

FIG. 3 RESULTS FROM PRODUCTION CONTROL

places in his department, is constantly reminded of his coming failure, not only by the progress record but by the daily inspection of the superintendent on his rounds of the several departments.

Incapable foremen soon learn that they must improve or someone else will fill their places. It is no uncommon occurrence for a foreman to come to the superintendent, saying he cannot measure up to the job and asking to be relieved and put back on productive work. Nor is it uncommon for the methods to disclose latent executive ability of a high order, that has been of great future value to an organization.

Some of the points which have been kept in mind in developing and installing control methods of practical and permanent value to furniture plants in the South, are:

1. Making foremen the source from which promises are given, then holding them to a responsibility for keeping these promises.
2. Placing in the foreman's office all detailed information needed for prompt and efficient work in his department, then seeing that he uses it.
3. Relieving foremen of all clerical detail, at the same time seeing that needed detail is carried on and that they make use of resulting records.
4. Spending little time on those things which are being done according to promises made, but giving extra attention to things which are not being done as they should be.
5. Training foremen to understand that they are leaders; that as leaders their own success depends upon their ability to inspire the workers under them in producing more work, of higher quality and at lower cost.

Unless these methods are fully understood by the foremen and the results secured from their application made known to them, the management has not accomplished all that it should in educating the foreman to a better understanding of his job and its opportunities. The best results have been secured in plants where a weekly meeting, such as has been outlined in the first part of this article, affords a chance for management and subordinates to get together and work out plans for better results.

The results which have come from introduction of practical production control methods have been secured because perfection has not been set as the goal. It has been found easier to schedule and secure a 95 per cent efficiency in performance than to attempt the ultimate 100 per cent, with its added need for detail and higher clerical cost.

Converting Failures Into Successes

Where such methods have failed it is well to investigate this phase of the problem before condemning the methods as being impractical or too costly to operate in a given plant. The writer has encountered instances where this new viewpoint has changed methods which could not be made to work, into plans which proved extremely profitable and satisfactory.

The final test of any methods are the results produced through their use. The executive wants to know, not only to what extent others have been benefited, but what he can expect if they are applied to his own business and his own work.

The chart shown in Fig. 3 shows results which have come from production control in a number of furniture and wood-working plants. The data given were taken at early stages in operating the new methods. The degree of progress varies; 95 per cent efficiency today may mean but 80 per cent efficiency next week or next month. In every instance the increase in output and reduction in cost shown in the chart have brought increased wages to employees and larger profits to the employer.

(To be continued in the November issue.)

National Association of Foremen

T. B. FORDHAM, President of the Ohio Federation of Foremen's Clubs, is calling a meeting of delegates from the various city foremen's clubs and inviting any other persons interested to meet at the Y. M. C. A., at Dayton, Ohio, October 8, at 10 A. M., to form the National Association of Foremen.

The rapid growth of foremen's clubs in many cities all over the United States, coupled with the keen interest of both the management and the foremen in the subject of better foremanship, has made desirable the expansion of the Ohio Federation to take in clubs and individuals outside of Ohio. About 1500 men attended the Second Annual Convention last May and many new clubs are to be formed this September.

All factory foremen's clubs, and all organizations or persons interested in raising the standard of foremanship are cordially invited to be represented at this meeting.

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 100 magazines; it also includes the publications of some 50 book publishers and professional societies so far as these are of managerial interest to manufacturing executives. The number at the right of each item is the index symbol according to the Dewey Decimal Classification System. If articles are clipped and filed according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. The books and pamphlets indexed can be procured from the Management Publication Corporation or from their respective publishers. Photostat copies (white printing on black background) of any magazine article indexed can be obtained at a *price of 25 cents the page,* by addressing the Engineering Societies Library, 29 West 39th Street, New York City. Remittance must accompany the order. When ordering photostats please quote from the index: (1) Title of article; (2) Index number; (3) Name, date, and page numbers of periodical in which the item appears. The editors will be glad to furnish on request additional information in regard to the management of manufacturing industries, and on industrial buildings and equipment.

Industrial Buildings and Plant Maintenance

Buildings and Equipment

Dodge Rushes $8,000,000 Addition. 658.23
Kenneth D. Cassidy, *Michigan Manufacturer and Financial Record,* August 22, 1925, pp. 5-6. Illus. New plant units with last word in equipment, will increase production to 1500 cars daily.

Modern Specialty Plant at Orillia. 658.23
Canadian Woodworker, August 1925, pp. 47-49. Illus. Canada Wood Specialty Co. recently completed thoroughly equipped factory for manufacture of a wide variety of products.

New Equipment Increases Plant Efficiency of South Elgin Sand and Gravel Co. 658.23
Cement, Mill and Quarry, August 20, 1925, pp. 26-28. Illus.

New Features of Engineering Design Applied to Latest Cement Plant. 658.23
Pit and Quarry. Sept. 1, 1925, pp. 71-83. Illus. Standard Portland Cement plant completed. Has modern equipment and shipping facilities, and excellent location.

Pugent Sound Plant of State Gravel Co. 658.23
W. A. Scott. *Cement, Mill and Quarry* August 20, 1925, pp. 9-11. Illus. Methods and equipment used.

Steel Frame Textile Mill Building With Concrete Floors. 658.23
Engineering News-Record, August 27, 1925, pp. 341-344. Illus. Details of design and layout which tended to economize floor space and cut time and erection cost with steel. Floors are wood block, wood sash, double glazed, and fire escapes are enclosed stairways.

The Best Plant for Candy Making—II. 658.23
Morgan G. Farrell. *Candy Factory,* Sept. 1925, pp. 35-36. Cleanliness, light and ventilation.

The Modern Manufacturing Plant. Westinghouse Transformer Plant at Sharon Represents the Latest in Industrial Building Practice. 658.23
C. H. Champlain. MANAGEMENT IN MANUFACTURING, Oct. 1925, pp. 181-186. Illus. Buildings, plant layout and equipment for rapid, straight-line production. One of world's longest factory buildings is in the group. Heating, ventilating, power, material handling, fire protection and sanitary facilities are described.

Maintenance and Repair

Floors: Their Construction and Upkeep. 658.58
K. D. Hamilton. *Factory,* Sept. 1925, pp. 390-394, 440, 442, 444, 446, 448, 450, 452, 454. Illus. Analysis of floor materials and outline of methods to avoid maintenance expenses on floors improperly laid and maintained.

Have You the Right Floors? 658.58
K. D. Hamilton. *Factory,* August 1925, pp. 201-206, 318, 320, 322, 324, 325. Illus. Experience of the George E. Keith Co. in the selection, maintenance and usefulness of various kinds of factory floors.

The Maintenance Department of the Modern Factory. 658.58
C. C. Hermann. *Belting,* August 1925, pp. 24, 26, 28. Illus. Its location for accessibility is of great importance in laying out the factory.

General Management and Policy

Administration and Policy

Getting the Most Out of Your Machine Tool Dollar. 658.27
E. R. Norris, *American Machinist,* August 13, 1925, pp. 255-256. Written from the experience of the Westinghouse Electric & Mfg. Co. Every three months a physical review is made of equipment. This is checked to determine the additional equipment needed for greater production, replacements to introduce machines more suitable for work being done, and replacement of equipment worn out.

Invade Motor Insurance Field. 629.113:368
Michigan Manufacturer and Financial Record, August 8, 1925, pp. 5, 27. Entrance of auto manufacturers into fire and theft risk business held blow to agency trade.

Should Car Manufacturers Make Their Own Accessories? 338.4
J. H. Marks. *Automotive Manufacturer,* August 1925, pp. 17-18. Definition of accessory the starting point; early accessories now essential; each manufacturer has a different problem.

Economics

American Engineering Standards Committee Year Book—1925. 621(058)
72 pp. Reviews year's work, outlines purpose, organization and procedure of the A. E. S. C., its relation to industry, the government and foreign standardizing bodies, lists projects completed, under way and proposed and gives data on membership.

American Labor Year Book—1925. 331(058)
Labor Research Department, Rand School of Social Science, New York. 6th Edition. 488 pp. $3.00. Provides authoritative source for the facts on labor conditions, the labor movement, and the progress made toward changing and bettering working conditions. Much material is brought together which otherwise would be very difficult to secure in organized form. Titles of the 16 sections are: Industrial and Social Conditions; Trade Union Organization; Labor Disputes; Labor Politics; Labor Legislation; Court Decisions Affecting Labor; Civil Liberties; Workers' Education; Labor Banking; Co-operation; Public Ownership; International Relations of Labor; Labor Abroad; Death Roll of 1924; Recent Books and Pamphlets; International Labor Directory.

An Introduction to Business. 338
H. H. Maynard, and Walter C. Weidler. Ronald Press Co., New York. 616 pp. $4. Developed primarily to form the basis of a survey course on agriculture, business, industry and transportation. Intended to be basic enough to serve as a common foundation for later and more specialized studies. The point of view of the work stresses the field of economic relations as directly affecting life work and living conditions. From this point of departure this survey builds a concrete document from the materials of commerce, industry and business organization, making it possible to prepare students for a later study of economic principles, business organization and industrial engineering.

An Introduction to Statistical Methods. 311
Horace Secrist. Macmillan Co., New York. 584 pp. Revised edition. Originally published 8 years ago, before the remarkable development in the use of statistics and the extensive demand for quantitative data came about. Now entirely rewritten and enlarged to include the progress made in the technique of gathering, compiling, and using statistics since 1917. Primarily an introduction to the subject of statistical analysis, but broad enough in scope to supply a thorough understanding of the elementary principles of statistics and statistical methods.

Labor Laws of the United States with Decisions of Courts Relating Thereto. 331.261
Bureau of Labor Statistics, U. S. Dept. of Labor. Bulletin No. 370. 1240 pp. $1.60. Digests and summaries of certain classes of laws affecting labor. Text and abridgement of labor laws of each state and of the United States.

Purchasing Power of the Consumer. 331.2
William A. Berridge, Emma A. Winslow, and Richard A. Flinn. A. W. Shaw Co., Chicago. 318 pp. Contains the three prize-winning essays in the J. Walter Thompson Contest for a statistical index of the purchasing power of the consumer in the United States. The first essay develops an index of earnings and purchasing power of factory workers. The second essay gives the results of detailed studies of expenditures as a basis for an index of purchasing power. The last essay establishes the fact that the ratio between the number of applicants for employment and actual employment available in public employment offices may be used to record variations in purchasing power.

The Science of Prices. 338.5
John A. Todd. Oxford University Press, American Branch, New York. 264 pp. $2. Written with the object of making plain that economics is a systematic study of ordinary business and social relations, and to show how to apply its principles to every-day problems. Topics discussed cover: Value; supply; land; land tenure; labor; capital; organization; demand; equilibrium of supply and demand; distribution; private property; social reforms; legislation; trade unions; co-operation and profit sharing; monopolies and trusts; socialism; and an outline of economic history. An appendix gives statistics on economic subjects.

Union Scale of Wages and Hours of Labor, May 15, 1924. 331.22
Bureau of Labor Statistics, U. S. Dept. of Labor. Bulletin No. 388. 234 pp. $0.25. Classified by selected cities and also by trades.

Management

Aroused Executive Interest Aids Effective Production Control. 658.5
C. F. Scribner, MANAGEMENT IN MANUFACTURING, Oct. 1925, pp. 217-220. Plans for production control applicable to a small plant and particularly developed from the practice of furniture factories. Many of the records are shown in detail.

Better Management Pays in Textiles. 658:677
Sanford E. Thompson and Willard E. Freeland. MANAGEMENT IN MANUFACTURING, Oct. 1925, pp. 209-212. Illus. Improved methods that were introduced into the various departments of large, well-equipped mills, and simplification of processing and savings in costs brought about.

Can Business Prevent Unemployment? 658.3137
Sam A. Lewisohn, Ernest G. Draper, John R. Commons and Don D. Lescohier. Alfred A. Knopf, New York. 226 pp. $2. Attacks the matter of unemployment from the point of view that it is a needless waste which cuts down business profits. The authors believe that "to a very considerable extent unemployment is caused by neglect." Building upon this opinion they present methods used by a number of representative concerns in reducing unemployment in their own establishment. The book is well worth reading by any manufacturing man.

Can the Textile Industry Be "Fordized?" 658.677
Thayer P. Gates. *Textile World*, August 15, 1925, pp. 37, 39. The author believes that the methods which have brought success in automobile manufacture can be used by textile mills to overcome the handicaps of prejudice and precedent and bring the textile industry into a leading position. The good produced under such a plan should show a profit at a price below competition.

Do Branch Plants Pay? 658
A. G. Anderson. MANAGEMENT IN MANUFACTURING, Oct. 1925, pp. 187-190. Cost and earning comparisons of two plants each of which operates branch factories. In one case the study showed an advantage in consolidating factories in one location; in the other greater possible earnings are shown by operating the factories separately.

Factory Organization and Administration. 658
Hugo Diemer. McGraw Hill Book Co., New York. 398 pp. New fourth edition. $4. Brings up to date the material in previous editions, dealing with the development of industrial engineering; financing and organizing a business; locating and laying out the plant; establishing and operating the various departments; cost accounting; material control; time study and wage payment; and the principles underlying good management. Details are given so that the book may serve as a treatise for manufacturing executives. Recent developments in human relations, the functions of general managers, and simplified production control are new topics incorporated.

Fundamentals of Business Organization. 658
Webster Robinson. McGraw-Hill Book Co., New York. 230 pp. $2.50. A formulation and discussion of what the author classifies as the eight fundamentals of business organization: Definite and stable policies; functionalization; the right man in the right place; directions; supervision; control; delegation and co-ordination of authority and responsibility; and incentive. These basic factors enter into all businesses, regardless of their size or character. They are here analyzed and explained as to their necessity, constituent elements, general applicability and most satisfactory methods of employment.

How to Lower Costs the Big Issue. 658:674
A. W. Williams. *Canadian Woodworker*, August 1925, pp. 41-42. Volume of business fairly satisfactory but prices are too low. Lower production costs real necessity.

How We Cut Overhead 80 Per Cent. 658
John N. Willys. *System*, Sept. 1925, pp. 263-268, 306, 308, 310. Illus. Description of methods used in the Willys-Overland Co. to reduce both administrative and selling expenses.

Industrial Research. 6(072)
L. A. Hawkins. *American Machinist*, August 27, 1925, pp. 336-338. Illus. Industrial research may be in pure science, in development of product or processes or considered with some immediately practical shop problem. Several instances of practical results from fundamental research are given.

Making a Success of the Small Manufacturing Plant—II. 658
C. U. Carpenter. MANAGEMENT IN MANUFACTURING, Oct. 1925, pp. 195-198. Practical methods and counsel as to how to run a small shop. Such matters are taken up as scheduling work, making cost estimates, preventing excess inventories and controlling expenditure of money.

Making Salvage Work Do Double Duty. 658.5671
Richard Cragin Daniels. *Factory*, August 1925, pp. 214-216, 308. Illus. From the experience of the Ternstedt Mfg. Co. the

author declares the salvage force can be made an important link in the work of production engineering, production control, inspection and cost control.

Manufacturing Procedure Simplified—II. 658.5
John R. Bangs, Jr., MANAGEMENT IN MANUFACTURING, Oct. 1925, pp. 213-216. This article treats manufacturing procedure from the purchase order to the detailed instruction sheet.

National Association of Office Managers. 651.372
Proceedings of the 6th annual conference, June 1925. F. L. Rowland, Secretary. Lincoln Natl. Life Ins. Co., Fort Wayne, Ind. 113 pp. $2. Addresses and discussions cover wage incentives, personnel, reports, waste elimination, training, communicating systems, employees' clubs, budgets, handling callers, relation of education to business and industry, business perspective.

Principles of Industrial Organization. 658
Dexter S. Kimball. McGraw-Hill Book Co., New York. 436 pp. $4. This third edition of a widely known and firmly established text on the science of management has been entirely rewritten, rearranged and enlarged. The tremendous development since 1919 in our knowledge of the ways and methods of management, their applications and results, is the occasion for this new volume. It is thus adequately abreast of the present status of our most rapidly developing branch of engineering. In this revision special attention has been given to the methods and mechanisms of management devised to control production. The presentation of the economics of production as given is not included in any other work. A wealth of topics are discussed, supplemented by liberal use of reference to standard works as one of the outstanding features. Without doubt this book is the leader among educational texts on industrial organization and administration.

Tendencies Affecting Automotive Management Methods. 658:629.1
James H. Collins. *Automotive Manufacturer*, July 1925, pp. 11-13. The price cycle, price changes and their effects, increases in productive capacity, extent to which market has been developed.

The Financial Executive's Part in Management. 658.14
D. W. Harris. American Management Association, New York. 16 pp. Emphasizes the duties of the financial executive, the primary one of which is to insure a fair return upon invested capital.

Power Generation and Transmission

Fuel

What Chemists Are Working on for Future Fuels. 621.434
D. H. Killeffer. *Automotive Manufacturer*, July 1925, pp. 23-25. Automotive manufacturer's problem, improved yields, motor efficiency, high compression developments, benzene production small, alcohol offers solution.

Wood Waste Used as Fuel for Power Plants. 621.182
H. W. Beecher, C. C. Simeral and C. L. Young. *Power Plant Engineering*, August 15, 1925, pp. 837-840. Illus. Several furnace designs specially developed to burn wood waste which presents difficulties, its physical character and its high moisture content.

Power Plant and Equipment

Contractors for Industrial Motor Control—III. 621.313
W. Wilson. *World Power*, Sept. 1925, pp. 127-134. Illus. Operating coils, contacts, off-stops, general notes on design.

Ford Plant Enlarges Power Capacity. 658.261
George E. Hagemann. MANAGEMENT IN MANUFACTURING, Oct. 1925, pp. 205-208. Illus. Equipment and methods of operating River Rouge power plant, eventually to be one of largest turbo-generator stations in the country, when installations now under way are completed. Special reference to economies brought about.

Maintenance of Large Motors in Steel Mills. 658.26
O. Needham. *Industrial Engineer*, Sept. 1925, pp. 423-426, 456-457. Illus. Including methods of protecting equipment from dust, dirt and sweating together, with tests that should be made periodically on the machines.

New Boiler Plant Saves Tannery $10,000 a Year. 658.261
Power, August 25, 1925, pp. 274-276. Illus. Description of the new power plant of the Forsyth Leather Company, which includes stoker fired return-tubular boilers and mechanical equipment for coal and ash handling. The investment of $60,000 pays dividends of 16⅔ per cent.

Problems of Steel Mill Operation. 658.26
Arthur J. Whitcomb. *Industrial Engineer*, Sept. 1925, pp. 406-414, 457-458. Illus. Recent progress in use of electrical and mechanical power-drive equipment, and tendencies in power generation, distribution and application.

Small or Large Motors for Industrial Plants. 621.313
Morgan G. Farrell. *Power Plant Engineering*, Sept. 1, 1925, pp. 901-905. Statement of the advantages and disadvantages of group drive compared with individual motor drive. The advantages of the group system are summed up as: Lower first cost, higher power factor, less upkeep, greater power reserve, greater flexibility.

Standards of the Hydraulic Society. 621.2
The Hydraulic Society. Booklet. 34 pp. Obtainable from any pump manufacturer who is a member, or from the secretary, 90 West Street, New York. The third edition of "Standards in the Pump Industry." Contains a viscometer conversion chart; tables of water friction in pipes; a standard classification of pumps; standard nomenclature and definitions pertaining to the industry; standard dimensions for cast-iron flanges and cast-iron flanged reducers for 125 lb. and 250 lb. steam pressures, as adopted by the A. S. M. E.; and a list of chemical and other special liquids, specifying the materials recommended in the construction of pumps for handling them.

Switchboard Meters for Power Plants. 621.37
J. Elmer Housley. *Power*, Sept. 8, 1925, pp. 362-364. Illus. Description of switchboard meters for both direct and alternating current plants. Information to determine proper scale range for instruments and selection of their transformers.

Using Graphic Meters for Detecting Grounds. 658.26
R. H. Bahney. *Industrial Engineer*, Sept. 1925, pp. 415-417, 459. Illus. Methods used in the Central Steel Co. plant on D. C. distribution and power service equipment, with charts and results obtained.

Power Plant Operation

Executive Control of Power Economy. 658.26
Walter N. Polakov. MANAGEMENT IN MANUFACTURING, Sept. 1925, pp. 129-132. Ways and means to secure lowest operating costs in producing power. This is a complex factor made up of the relative best efficiency of equipment, and lowest cost of labor and materials and supervision.

Some Economies in the Steam Plant. 658.261
James H. Blake. *Engineering Journal*, Sept. 1925, pp. 379-382. Causes of loss of economy, means of utilizing waste heat, condensation and radiation, exhaust steam.

The Cheapest Labor for the Power Plant. 658.26
Matthew W. Potts. *Industrial Management*, August 1925, pp. 116-121. Illus. Mechanical methods of handling coal and ashes.

Power Transmission

Group Drives with Leather Belts in Two Chicago Plants. 658.2621
W. H. Mack. *Belting*, August 1925, pp. 13-15. Illus. Borg & Beck Co. and Nye Tool & Machine Works use group drive to advantage throughout their plants.

Planning a Lineshaft Installation. 658.262
Frank E. Gooding. *Industrial Engineer*, Sept. 1925, pp. 418-422, 460. Illus. Factors which determine size of shaft required, and affect method of grouping machines on shafts that transmit power to them.

Marketing and Distribution

Advertising

How to Write Advertising. 659.13
Howard A. Barton. J. P. Lippincott Co., Philadelphia. 275 pp. Illus. $2.50. Deals exclusively with copy writing. Written from extensive experience in the preparation of advertising copy. It takes up the work, step by step, from the consideration of the product to be sold through details of headlines, layouts, art work, style, action, to the finished advertisement. It outlines the technique of presentation from beginning to end. Arranged in logical sequence and shows "how it is done."

Selling

Commercial Survey of the Philadelphia Marketing Area. 658.82
J. Frederid Dewhurst. Department of Commerce, Washington, D. C. Booklet. 130 pp. $0.20. This is the first of a series of regional surveys covering marketing practices and methods, purchasing power and inclination and other data of an essential nature for judgment of the worth of sectional markets in the United States. Its purpose is to assist sales executives to set quotas and plan campaigns on the basis of knowledge rather than guesses. It should be of substantial aid in elimination of waste in our present system of distribution.

Foundry Sales Methods That Made Money. 658.85:672
Iron Age, August 13, 1925, pp. 401-404. Illus. Outline of several methods which have proved their worth in increasing sales of foundry castings. Service to customers is one of the most important features.

How the National Cash Register Company Selects Salesmen. 658.8
F. B. Patterson. *Printers' Ink Monthly*, August 1925, pp. 21-22, 94-95. Description of the methods used by the National Cash Register Company. The observation is made that while college graduates are not the chief source of supply the turnover among them is lower than for any other class.

Insurance of Credits. 368.8
Austin W. Hyde. *Michigan Manufacturer and Financial Record*, August 29, 1925, pp. 4-5. Its inception, determination of rates, benefits under policy, protection against unforseen loss.

Managing the Interview. 658.85
J. C. Aspley. The Dartnell Corporation, Chicago. 118 pp. Pocket edition. $1.10. One of a series of standard manuals for salesmen in all lines of business. Summarizes and illustrates actual methods used to increase the effectiveness of the time they spend face-to-face with buyers and prospects. Deals with successful interviews; arousing the buyer's attention, interest and desire; use of sales portfolios, samples and demonstrations; overcoming difficulties; getting the order; and using one sale to make another.

Merchandizing the Motor Car. 658.8:629.1
James H. Collins. *Michigan Manufacturer and Financial Record*, August 29, 1925, pp. 5-6. Stabilizing is greatest need, problem one of management, changing dealer organizations, developing market.

Shipping

Analyzing Freight Rate Problems in the Non-Metallic Industries. 656.23
L. E. Whitney. *Pit and Quarry*, II—August 15, 1925, pp. 89-90. Some decisions of the I. C. C. III—September 1, 1925, pp. 97-98. Proposed freight rate increase in the western territory.

Motor Trucks in Railroad Transportation. 656.2
G. C. Woodruff. *Automotive Manufacturer*, August 1925, pp. 8-10. Trucks as allies; probably better for less-than-carload loads; give more and better service through collections and deliveries.

Selecting the Proper Container. 658.7884
MANAGEMENT IN MANUFACTURING, Oct. 1925, pp. 199-200. Illus. A listing and discussion of the many factors that the manufacturer must weigh to bring about economy in shipping costs.

Standard Boxes for Packing Bolts. 658.7884
Iron Age, August 20, 1925, pp. 468-470. Illus. Proposed standard packages and packing for bolts, nuts and rivets. The packages are arranged in special multiples of unit size. It is estimated that the adoption of these containers would bring an annual saving of $12,000,000.

Material Handling and Production Control

Material Control

Worthington Methods Cut Tool Costs. 658.281
Anker L. Christensen. MANAGEMENT IN MANUFACTURING, Oct. 1925, pp. 201-204. Charts. Sixth and concluding article on tool control methods at the Worthington Works, representing the latest and most efficient developments in this field. The final article deals with the determination of the best tools for each job and how to find out whether it is more economical to make or buy each kind of tool. Actual savings made are shown.

Mechanical Handling

A Typical Big Plant with a Variety of Products. 658.281
Matthew W. Potts. *Industrial Management*, August 1925, pp. 89-95. Illus. Methods of handling materials at the East Pittsburgh plant of the Westinghouse Electric & Mfg. Co.

Adapting Handling Methods to Plant Expansion. 658.281
Matthew W. Potts. *Industrial Management*, August 1925, pp. 77-82. Illus. Chapman Valve Mfg. Co. methods.

General Electric Transportation. 658.281
Guy Bartlett. MANAGEMENT IN MANUFACTURING, Oct. 1925, pp. 191-194. Illus. Plan developed and equipment used, which includes everything from hand trucks to complete industrial and standard gage systems and rolling stock. Over 26,000 carloads of materials, comprising 575,000 tons of incoming supplies or outgoing products, were handled in 1924.

Handling—The Hidden Cost of Industry. 658.281
R. M. Hidey and C. H. Kraft. *Factory*, Sept. 1925, pp. 369-373, 482, 486, 488, 490, 492. Illus. Methods used to save handling costs in two plants, White Motor Co., J. L. Kraft & Bros. Co.

Handling Diverse Products Through Many Operations. 658.281
Matthew W. Potts. *Industrial Management*, August 1925, pp. 73-76. Illus. Fuller Brush Co. methods.

Handling Materials by Air in Industry. 658.281
Charles L. Hubbard. *Industrial Engineer*, Sept. 1925, pp. 427-431, 454-456. Illus. Equipment and quantity of air required, different materials which may be handled, and advantages and economies resulting.

Handling Under Difficulties. 658.281
Matthew W. Potts. *Industrial Management*, August 1925, pp. 67-72. Illus. Methods at the Brown & Sharp Mfg. Co. plant.

Industrial Handling—The Hidden Cost of Industry. 658.281
I—The Importance of Industrial Handling; II—Savings We Didn't Think Were Possible; III—Economies Beyond the Cost Figures; IV—Is It, Today, the Best for the Job?; V—The Method Must Fit the Machine; VI—Quick Return on the New Investment; VII-XIII—What Equipment Made the Savings? *Factory*, August, 1925, pp. 183-192, 224-225, 232-233, 240-241, 246-247, 254-257, 264-265, 272-273, 276, 278, 280, 282, 284. Illus. Gives cost and savings data from a number of different industries.

Materials Handling and the Price of Soap. 658.281
Matthew W. Potts. *Industrial Management*, August 1925, pp. 109-115. Illus. Methods at the Procter & Gamble plant at Port Ivory.

Materials Handling in Multi-Storied Buildings. 658.281
Matthew W. Potts. *Industrial Management*, August 1925, pp. 83-88. Illus. Crompton & Knowles Loom Works methods.

Mill, Tramway and Rock Crushers of Superior Cement Co. 658.281
W. A. Scott. *Cement, Mill and Quarry*, August 5, 1925, pp. 9-14. Illus. Material handling features of plant.

Reclaiming in the Cement Industry. 658.281
C. H. Sonntag. *Pit and Quarry*, Sept. 1, 1925, pp. 59-66. Illus. Methods and machinery used in removing limestone, clay, coal, gypsum, clinker, etc., from storage.

Production Methods and Control

A Modern Heat Treating Department. 658.27
E. L. Wood. *Forging—Stamping—Heat Treating*, Sept. 1925, pp. 290-292. Illus. Methods and equipment at the Geometric Tool Co. plant.

A Survey Concerning Night Operation. 658.3812
R. N. Van Winkle. *Pit and Quarry*, Sept. 1, 1925, pp. 85-87. Opinion is divided as to its efficiency in quarry operations.

Automatic Equipment Paints Ten Ford Frames a Minute. 658.27:629.1
Automotive Manufacturer, July 1925, pp. 19-20. Improved continuous arrangement which cleans, paints, dries and delivers finished units to freight car door at this rate.

Automotive Factory Labor Costs Cut 10 to 5 Per Cent in Last Two Years. 658.5
Norman G. Shidle. *Automotive Industries*, Sept. 10, 1925, pp. 401-403. Outline of improved production methods which have reduced labor costs but not labor earnings. Improved methods of handling material is one of the outstanding features.

Charts That Help a Small Plant Grow. 658.5
H. W. Case. *Factory*, Sept. 1925. pp. 382-384, 396, 398. Illus. Production and shipment records used in controlling the work in the plant of the Alden Mfg. Co.

Drafting Methods. 621.75
Douglas E. Trowbridge. Codex Book Co., New York, 155 pp. 97 Illus. $2.50. A very helpful book for the practical draftsman, explaining drawing instruments and their use; lettering; symbols and abbreviations adopted by the leading engineering societies; filing methods for engineering data; 27 useful instrument kinks; 48 practical drafting kinks; with a short chapter on "nevers and don'ts." Written out of a wide experience. The author presents his subject with the idea of helping to bring about standardization, cutting out waste of labor and materials, and saving money in the drafting room.

Piling Lumber and Dimension Stock for Drying. 658.78:674
Thomas D. Perry. *Wood Working Industries*, Sept. 1925, pp. 31-34. Illus.

Simplified Factory Accounting and Routing. 658.5
Frederick A. Waldron. Ronald Press Co., New York. 113 pp. $1.25. Outlines, in sequence, the steps necessary in installing a management system. Gives methods and forms for the conducting of a manufacturing enterprise at a minimum of expense. Presents the subject from the viewpoint of the manager. Covers the following topics: Organizing for operation; engineering division; tool room; control of materials; production division; accounting; employment; and planning for the future.

Systematizing Foundry Production. 658.561
Gilbert L. Lacher. *Iron Age*, August 27, 1925, pp. 527-529. Illus. Details of the production control system of a foundry doing jobbing work.

Employment and Personnel Management

Personnel

Content, Design and Use of the Roster Card—II. 658.3113
Public Personnel Studies, August 1925, pp. 214-225. Illus. System and forms suitable for recording data on industrial employees. Developed for use of public personnel agencies.

Cost of Labor Turnover. 658.3126
Harold Fischer. *Industrial Management*, Sept. 1925, pp. 150-152. Over $1,500,000 squandered annually by shifting of labor. Costs of hiring and firing are given for skilled and unskilled labor.

Cultivating the Will to Work. 658.3
W. C. Dickerman. *Michigan Manufacturer and Financial Record*, Sept. 12, 1925, pp. 5, 27. Stimulation of man power brings forth many unique methods in last decade.

How Far From His Job Can a Worker Live? 658.3
Michigan Manufacturer and Financial Record, August 29, 1925, pp. 3, 27. Motor car and good roads explain expansion of Michigan cities.

Paid Vacations for Workers. 658.3816
John Nelson. *Iron Age*, Sept. 17, 1925, pp. 743-744. Plan of the Norton Co., whereby out of 2100 employees 1200 are entitled to vacations. A prerequisite to eligibility is three years of service.

The Foreman and His Responsibility. 658.31243
J. W. Murphy. *Railway Mechanical Engineer*, Sept. 1925, pp. 543-544. He must have an ideal and be a leader.

Remuneration

A Management Viewpoint of Extra Incentive Wage Plans. 658.3225
Frank P. Cox. American Management Association, New York. 8 pp. pamphlet. The author, manager of the West Lynn works of the Veneral Electric Company, declares that the wage incentive puts money into the hands of the operator, reduces cost of production, reduces inventory, investment, and equipment and increases the wealth of the nation and benefits the community.

Extra Incentive Wage Plans From a Psychological Point of View. 658.3225
Harry D. Kitson. American Management Association, New York. 8 pp. booklet. Describes the effect of the bonus system, in increasing production and declares that wage incentive should be regarded as a potential beneficient device which leads the worker to produce more by eliminating waste and saving time and effort. The worker should profit financially and perform his tasks with less fatigue and weariness than under the old methods.

Profit Sharing. 658.324
Ralph E. Heilman. American Management Association, New York. 12 pp. pamphlet. A short outline of profit sharing and its effects. The opinion is advanced that it is not a panacea or magic solution for the difficult problems that grow out of the employer-employee relationship.

Wage Incentives That Fit the Job. 658.32
Iron Age, August 27, 1925, pp. 534-535. Wage payment plans of the Packard Motor Car Co., Westinghouse Electric and Mfg. Co., Burroughs Adding Machine Co., and a foundry equipment company.

Safety

Safety—and Mechanical Handling. 658.3823
Matthew W. Potts. *Industrial Management*, August 1925, pp. 103-108. Illus. Minimizing the accident hazards with material handling equipment.

Saving Manpower and $65,000. 658.3823
H. D. Martin. *Iron Trade Review*, August 27, 1925, pp. 491-494. Illus. How Pollak Steel Co. effected great economies in 4 years at forge plant by self-insurance. Lost time cut 57,294 hours in a year at rolling mill. Value of schedule and experience ratings.

Some Cause of Wheel Failures. 658.3823
Otto J. Lof. *Abrasive Industry*, Sept. 1925, pp. 279-281. Grinding wheels break from known causes. A thorough investigation of each failure should be made at once. Effects of pressure, dry grinding, etc.

Woodworkers and Safety. 658.3823
E. R. Maule. *Wood Working Industries*, Sept. 1925, pp. 34-36. Most accidents occur from carelessness or thoughtlessness and the management must sell the idea of safety to the men.

Accounting and Financial Control

Accounting and Cost Finding

A System of Labor Control for Pay Roll and Cost Purposes. 657.452
Peter C. Jung. *National Association of Cost Accountants Bulletin*, Sept. 1, 1925. Booklet, 17 pp. Description of the method of labor control from the cost and payroll standpoint of the Claybourn Process Corporation, a small manufacturing concern producing printing machinery and equipment and employing about 150 persons.

Cost Accounting. 657.452
W. B. Lawrence. Prentice-Hall, Inc., New York. 528 pp. $5. A two-fold purpose has governed the writing of this book: as a reference for cost accountants and executives of manufacturing enterprises; as a text for courses in cost accounting. In developing this purpose, it develops the theories upon which the procedure of cost accounting is based and gives their practical applications in present-day manufacturing conditions. In scope it covers its subject from both elementary and advanced points of view. Thus all of the cost methods are given in detail with references to specific cost systems. Two unusual features are chapters on the "Advantages of Cost Accounting for Auditors" and "Legal Phases of Cost Accounting."

Cost Accounting. 657.452
J. P. Jordan and Gould L. Harris. Ronald Press Co., New York. 562 pp. Second edition, revised. $4. Introduces several new chapters and amplifies, rearranges and brings up to date the material presented in previous printings dealing with the principles and practices of cost accounting. Stresses particularly its relation to management. The aim of the methods presented is to maintain accuracy through rigid control accounts, so that the operating executives and department heads of a plant may have constant and reliable information to conduct the business to a higher plane of profits. Covers the entire field—production, material control, labor, burden, sales, administration, budgeting and the preparation and interpretation of financial statements.

Depletion: Its Meaning and How to Compute It. 657.458
H. R. Stutsman and Elmer T. Cummins. *Cement, Mill and Quarry*, August 5, 1925, pp. 23-26. Proper methods for income tax return purposes in the sand and gravel industry.

Industrial Power Plant Records Versus Costs. 657.452
H. H. Force. *Power*, Sept. 15, 1925, pp. 408-410. Illus. A record and cost system of 9000 kw. industrial power plant of the Continental Motors Corp. A complete distribution of costs is shown.

Our Largest Savings Come From Prompt Costs. 657.452
H. S. Owen. *Factory*, August 1925, pp. 199, 200, 218, 220. Illus. Method of the Ritter Dental Mfg. Co. in making a standard cost system function as a tool for stopping wasteful practices.

Practical Cost Accounting—II. 647.452
E. K. Rice. *Candy Factory*, Sept. 1925, pp. 41-42. Danger in the candy manufacturing industry of underrating overhead. Use of the Midland uniform cost accounting system.

Financial Control

Postum Tells How It Uncovered Hidden Profits. 658.14
C. M. Chester, Jr. *Printers' Ink Monthly*, Sept. 1925, pp. 19-20, 90, 93, 94, 97, 98. Results of the application of a budget system to the control of sales in the plant of the Postom Cereal Co.

New Industrial Equipment

Drop-Forged Bench Vise. 621.9
Made entirely of drop forgings, except for the handle. Lighter in weight than cast-iron type. Parts interchangeable. Knurled and forged jaw plates are doweled onto the jaws, and are replaceable. Base either stationary or swivel. Wedge lock is quick to set and automatic in tightening up. Made in four sizes: 3 in. with jaws opening 5½ in.; 4 in. with jaws opening 6 in.; 5 in. with jaws opening 8 in.; 5 in. heavy duty with jaws opening 8 in. Unconditional guarantee on all parts except jaw plates. Trade name Dropfo. Made by Fulton Drop Forge Co.

Electric Truck and Stacker. 621.86
For sheet metal, radiators, barrels, boxes, paper-flat or rolled, rubber fabric, and all bulky, odd-shaped loads. Special feature consists of a movable upright frame that can be tilted back to an angle of 40 deg. from a vertical position, against spring resistance, by means of a drum and cable. This frame carries a heavy fork which, when loaded, extends at right angles in front of the upright, but can be folded back, when empty, to save space. Fork travels up and down frame by means of a drum and cable attachment. Picks up load from skids and will transport it, either vertical or tilted back, and stack it. Jarring in transportation aligns such material as tin plate, etc. Storage battery drive. Steers on all 4 wheels. Standard safety features. Ball and roller bearings. Capacity 3000 to 5000 lb. Made by Elwell-Parker Electric Co.

Elevator Tructor for Oven Charging. 621.86
Handles boxes, or stacks, of parts into and out of gas, oil and electric heat-treating furnaces. Saves both time and heat. Load support reaching into oven consists of two 92 by 8 in. horizontal fingers with capacity for 10 300-lb. packed furnace boxes. These fingers are secured to two steel arms which raise or lower them on two 8 in. upright channels. Lifts are from 11 to 72 in. high, as required. Fingers extend into slots in the oven, and, when lowered, deposit load on oven bottom. Loads are removed from furnace by reversing the process. Elevating mechanism operates by means of motor-driven drums and cables. A double drum can be supplied if an extra cable line is required for pulling purposes. Driving wheels have rubber tires 22 x 4½ in. Trailer wheels, under load, are dual with rubber tires 10 by 6 in. Steers on all wheels. Made by Elwell-Parker Electric Co.

Improved Type Motor Starter. 621.313
A new form of motor starter and reversing switch permitting efficient reversing of the direction of rotation of a motor has been put on the market by the Westinghouse Electric & Mfg. Co. For industrial use—on carding machines in textile plants, etc.

Level and Pressure Indicator and Recorder. 621.1977
For use in reservoirs, tanks, vats, standpipes, blast furnaces, etc. Electrical operation enables indicators of instrument, and controls for level or pressure, to be located either at, or remote from, the point of measurement. Saves time, prevents waste, makes operation more efficient. Installed either within tank or outside by means of a pipe connection. Designed for pressures from 0 to 6 in. of water, and up. Automatically will start and stop pumps to control levels or pressures. Consists of U-tube in which rise of mercury cuts out resistance in the internal resistance element and alters current flow in proportion to head. Current consumption at maximum load equal to 40-watt lamp. Base is block steel and resistance element a tube of bakelite with contact rods across bore. Made by Republic Flow Meters Co.

Portable Elevator. 621.87
For piling or stacking barrels, boxes, etc. Made in hand- or electric-operated types, which are inter-convertible, as hoisting units are the same. Steel gears with cut teeth, enclosed in dust-proof housing. When elevating materials, weight of machine rests on two solid legs instead of the front wheels. Upright frame hinged 6 ft. above floor. Elevator platform interchangeable with other types. Upper limit switch, clutch which stops motor when load is being lowered, and automobile-type brake prevent accidents. Made by Barrett-Cravens Co.

Steel Filing Equipment. 651.5
Entire steel construction, made in all types and in all practical drawer arrangements. Arc-welded on inside. Open joints acetylene-welded. Heavy steel bar frame substructure at front and back of each unit. Drawer openings completely enclosed by horizontal partitions. Tilting one-piece and telescoping front. Roller bearing suspension slide. Lift out card tray in tray drawers makes discarding of cabinets unnecessary when changes occur. Bases designed for adding either legs or casters. Paneled and removable end pieces. Finished in solid green, or exact reproduction of mahogany or walnut. Made by Automatic File and Index Co.

MANAGEMENT
AND ADMINISTRATION IN
MANUFACTURING INDUSTRIES

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Skillful Use of Management Tools

Systematized Manufacturing Procedures Pay

"EVERY trade has its tools" is quite as true a maxim as "there are tricks to all trades." Management is no exception under this generalization for there are many tools ready for the manager's use, although they are called by other names. These mechanisms of management, as they are often termed, are of tremendous advantage to the manager in doing his work, in fact, are as necessary to him as the tools of the carpenter or machinist are to those mechanics.

Take away the workers' tools and they cannot produce; take away the manager's mechanisms and he can neither accomplish as much nor do what he does so well as if he utilized these aids to the fullest extent.

Under the general head of management mechanisms are included procedures, systems and methods, without perhaps a careful distinction between these terms as to their exact meanings. The following explanations, however, seem to be in line with accepted usage.

Management works through its own tools. The manager who makes fullest use of them does more than another who utilizes them less. The greatest successes in manufacturing management show the best mechanisms, systems, methods, procedures. In these cases the proof is positive that the mechanisms pay through savings and increase of earnings. However, like any other work or endeavor, there are degrees of skill in their use, with the greatest rewards to the most skillful.

Procedure is the dynamic or operative means for doing a given piece of work or attaining a given management result. Judgment, decisions, orders—acts of the will—are involved in procedure for it is concerned with getting things done. It may be a procedure of the moment, operating without plan or considered and arranged steps, or, in sharp contrast, it may work through organized system and method making use of all the best ways and economies in attaining the desired result.

System is the organized static or physical means for doing a given piece of work or reaching a given management objective. The term is applied to such things as a system of jigs and fixtures; an accounting system; a storeskeeping system; a budget system; a production control system, and so on. In many quarters, unfortunately, system is thought of as red tape, a lifeless hindrance to doing work, something to despise and disregard. Properly established, it is entitled to all respect as a useful and necessary management tool.

Method is a detail of a management procedure.

From another point of view procedure and method are the "how" of management and system the "what."

If these distinctions are accepted, managers ask these questions concerning system, procedure, and method: What can it do? How much help can it give the manager? How much can it increase earnings, the primary objective of every manufacturing concern?

The best answers are the records of actual cases, of certain experience. Drawing information from articles previously appearing in this magazine, results are given in the following paragraphs for the operation of three budget procedures, a suggestion procedure, a payroll procedure, a tool control procedure, a production control procedure.

Results of Budgeting

The Edison Industries have been operating on a budget basis for a number of years. W. B. Cloos, vice president and general manager of the Edison Portland Cement Company, says of his own operation:

"The results of our budget comparison are very satisfactory for the calendar year 1924. The actual

cost of cement in bins per barrel was 99½ per cent correct, production 95 per cent, sales 96 per cent, and profits 98 per cent."

L. W. McChesney, vice president and manager, Primary Battery Division, reported that the budget for the Primary Battery Division in 1924 was 97 per cent correct as to sales and 98 per cent correct as to profits.

Nelson Durand, vice president and general manager, Ediphone Division, writes: "Last year our budget of sales was 94 per cent correct, and our budget of profits 93 per cent correct."

The Hood Rubber Products Company has in use a sales budget plan based upon pre-determination of the ratio of selling expense to sales volume that will permit profitable operation. Experience shows that such a plan can be operated with a variation of one-half of 1 per cent between budget figures and actual figures compiled at the close of the fiscal year.

The Bell Telephone System utilizes an investment of almost $2,500,000,000 and provides efficient national telephone service. An indispensable factor in its operation is a continual, scientific budget which gives a complete summary of facts in regard to past and forecast construction, operation, and finance. Its accuracy is shown by the experience of 1924: Gross additions to plant exceeded the estimate by less than 5 per cent; total telephone revenues and expenses respectively varied less than 1 per cent from estimates.

Results of Employee Suggestions

Experience has proved that the man at the bench and on the machine has practical ideas as to ways for speeding up production without sacrificing quality or increasing his own efforts. To bring such ideas forward regularly, investigate them and pay cash awards for those accepted, the General Electric Company some five years ago formed a suggestion system.

The figures show that in 1923 the committee received and reviewed 4850 suggestions. Of this number 908 were accepted. For these the successful suggestors received in awards the sum of $15,095. The records for the first six months of 1924 show that the popularity of the plan is increasing. In this period 2531 suggestions were received from an average of 19,000 employees, an equivalent of about one for each 8 workers. It is noteworthy that 30 per cent were accepted, where but 21.7 per cent were favorably reported upon during 1923.

Results of Payroll Procedure

The American Rolling Mill Company desired to obtain prompt, reliable information in regard to the efficiency of the labor force and accurate information as to expenditures for labor. The method adopted was to install a payroll system designed (1) to give information in regard to what workers were doing, (2) to balance the payroll daily. Briefly, the objects obtained by the procedure based on this system are:

1. The daily balanced payroll and payroll distribution make it possible to pay off a worker immediately when he leaves the employ of the company.
2. The company payroll is ready for payment a few days after the close of the payroll period. The labor distribution is delivered to the cost department two days after the close of the month, enabling the cost sheets to be completed as early as the 5th of the month.
3. Daily balancing of the payroll and payroll distribution equalize the clerical work over the entire payroll period, thus eliminating high pressure on the department at the close of the payroll period and the end of the month.
4. The superintendents receive daily reports of the efficiency of the working force.
5. The employee has complete information as to the method of figuring his pay and determining his bonus earnings.
6. Complete records are provided for each employee for income tax purposes.
7. Complete attendance records are provided.
8. Due to the automatic checks on the payroll, disputes as to pay are practically unknown.

Results of Tool Control

The tool control system and procedure of the Worthington Pump and Machinery Corporation is recognized as one of the best in the United States. A year was required to put it into operation.

The economic results are convenience and dispatch in giving out tools when required, certainty of knowledge as to where any tool or tools may be at a given time, and precise information to answer the questions: Is it more economical to buy or manufacture a given tool or line of tools? What is the most desirable life for a given tool or set of tools? Also there has been a reduction, attributable to this control system, of 30 per cent in the cost of taps, 20 per cent in the cost of drills, and 20 per cent in the cost of milling cutters.

Results of Production Control

Outstanding proof of the claim that production can be planned and precisely controlled over long periods of time was provided by the experience of the Holt Manufacturing Company. Here the unequalled record of 995 consecutive working days of production exactly according to schedule has recently been completed. Along with this record was a substantial reduction in production cost and the earning of a satisfactory manufacturing profit.

References might be multiplied in regard to other management procedures to show applications and advantages. Some 17 or 18 wage payment procedures are recognized as having merit, each particularly adapted to certain conditions; procedures for controlling stores and stock have been worked out in great detail; timekeeping procedures are numerous, many adapted to some particular mechanical device. All of these are management tools. The results from their application show the benefits of their skillfulness.

Factors of Industrial Housing

Plans Adopted for Typical Communities and Cost Data on 88 Important Projects

By RUSSELL J. WALDO

INDUSTRIAL housing is a worthwhile undertaking only when it attracts desirable employees and retains them after they are once on the payroll. No plant can prosper very long without a steady working force. Wherever the housing conditions of workers have been improved, however, the floating population has been largely eliminated.

For a long time to come we will find cities suburban to our larger manufacturing centers springing up almost overnight to meet the needs not of the general community but of the employees within plants who wish to live adjacent to their work places. Morgan Park, Firestone Park, Speedway City, Atlantic Heights, and countless other industrial suburbs have been laid out to meet this ever increasing need.

When a manufacturing plant outgrows its city location it often moves out to the suburbs of the city and there brings into existence a new community. This has happened in many of the larger cities such as Cleveland, Cincinnati and Chicago. These suburbs at first were separate from the city but in a short time they have found the city growing out to them.

Surrounding the plant with attractive homes has been accomplished in various ways. First, by investing the company's capital as a part of their necessary plant, second, by combining with other companies to raise the capital necessary to finance the building of the necessary homes, and third, by forming separate organizations to conduct the building operations and to manage the project.

The types of houses constructed vary with the prevailing types in the locality. In the majority of cases detached houses of various sizes are most popular. The prevailing material used in various communities, and approximate costs; the financial returns from houses, whether rented or sold; distance from the plant; size of lots, garden spaces, alleys, and streets; segregation of nationalities, or skilled and unskilled workers, will be given for a number of projects studied by the author.

Land to be used for homes of unskilled workers in the cases under consideration averaged approximately $500 per acre. In early ventures the cost was only $215 per acre for large parcels of land. In other cases as much as $876 per acre was paid. The land bought for skilled mechanics' homes ranged from $600 to $1160 per acre, the average being about $900. The land to be used for executives' homes was usually purchased upon the skilled workers' land value rating with the executives occupying the most desirable sections.

Rates for putting down public utilities, including water, sewer, sidewalks, curbing, and rough grading, ranged very close to $2100 per acre for detached houses. In some instances this figure was as low as $1840 but in the majority of cases it was slightly over $2100. Where houses were built in groups of two or more the rating would be above $2500.

The size of land parcels averaged 200 by 500 ft., but some plots were as long as 800 ft. Five homes per acre was about the average. With detached houses the minimum lot size was close to 30 by 80 ft. For attached houses an average width of street space allotted

FIG. 1 UNION PARK GARDENS, WILMINGTON, DELAWARE, AN EXAMPLE OF EXCELLENT INDUSTRIAL HOUSING

to each home was 15 ft. Where the houses were semi-detached the allotted space varied from 25 to 30 ft.

The normal run of wages for labor in the organizations studied ranged from $18 to $20 per week. The prevailing rates for skilled workers ranged from $25 to $35. Basing rent for the houses upon wages, the average was one week's pay for a month's rent.

The following table shows the average allotments for the various priced homes:

Lot, improved	$400	$500	$600	$700
House	$1600	$2000	$2400	$2800
Total	$2000	$2500	$3000	$3500
Wages per week	$15	$20	$25	$30
Wages per year	$780	$1040	$1400	$1560
Rent per month	$15	$20	$25	$30

The usual house of four rooms was designed with living room, kitchen, two bedrooms, and bath. In many cases convertible beds were used for visitors, and the kitchen served as dining room. The five-room house was designed with living room, kitchen, three bedrooms, and bath.

The price per linear ft. for sewers ran from 50 to 75 cents. House connections averaged from $28 to $30. Water cost approximately $1.45 per linear ft., with $18 for house connections. Sidewalks averaged from 55 to 90 cents per linear ft. For grading and rough curbing the average was close to $1.75 per linear ft.

From these figures the average development charge for a 15 ft. front is $66.95 and the connections $37, a total of $103.95, and a total cost of $1663.20 per acre for the terrace row type of house. Detached houses had a development charge of $218.20 for a 40 ft. front house and a total acre price of $1274.20.

The various cost percentages for three large projects, which were close to the average, were:

	Lots	*Streets*	*Parks, Etc.*
	Per Cent	*Per Cent*	*Per Cent*
Union Park	54.5	31.1	14.5
Loveland Farms	73.0	21.8	5.2
Neponset	62.5	19.5	18.0

During personal visits and through correspondence the writer questioned 88 executives on the following points:

Were your workers adequately housed prior to your entering the construction field? Sixty-seven responded that they were, and 15 responded that their employees were not properly housed according to the executives' ideas of proper standards of living. In six cases no response was made.

Did you build to provide reasonable rent? Seventy-nine responded that they did, while nine responded that their main reason was to bring their workers closer to the plant.

Are there other similar projects between yours and the main part of the city? Eighty-six replied that there were.

In every case the homes were built for the use of company workers only. In 51 cases workers were privileged to buy if they chose and in 36 cases the organizations preferred to own the houses themselves. In every case a worker was required to vacate when leaving the company's employ. If he had purchased he was required to sell to another worker. In only two of these cases did the employer pay back in full the amount paid in by the worker. The remaining 86 deducted one and one-half to six per cent for depreciation of the house. In every case the house was entirely redecorated and repainted at no additional cost to the new tenant.

FIG. 2 TWO-FAMILY HOUSE IN SACO-LOWELL MILLS GROUP AT NEWTON UPPER FALLS, MASSACHUSETTS

In 86 cases better housing of the employees encouraged better workers to come to the plant. Eighty-four firms reported that housing had been largely responsible for reducing labor turnover. Three gave no information on this point, and one reported that labor turnover had been increased. Upon questioning the workers in this plant it was found that just prior to the time when a large number left the employers had increased the workers' rental practically $5 per week. In spite of that many still worked with the firm and rented elsewhere.

Eighty-five firms had found it necessary to purchase land to build their homes upon. In only three cases were the number of houses so few that the company already owned sufficient land upon which to build. In 66 cases the land upon which the homes were built was within three blocks of the plant. In 22 cases the distance varied from three blocks to five, and in two cases was nearly one mile.

Forty-seven firms had either set trees along the streets or had planned to do so. Thirty-six had made no arrangements. In seven of these 36 cases they have since planted trees.

In 66 cases workers served upon the housing organization's advisory board. In 22 cases workers were not upon the board, entire control remaining with the employer.

Sixty-five took one week's pay for a month's rent,

20 took one-fifth of a month's pay, while three took only one-sixth of a month's pay.

Because of increased interest in the employer's work 17 increased wages from $3 to $4.50 per week within eight months after occupancy. Forty-seven of the employers built for the laborers because of their difficulty in obtaining housing facilities and did not build at first for the skilled workers. In 38 cases laborers were reported as being in the majority of those desiring to purchase. In 43 cases the skilled workers seemed to be in the lead.

Of the 51 cases where sale was possible 34 sold the houses at cost, while 17 sold at an increase of from two and one-half to five per cent to cover loss and depreciation. Eighty-seven reported that they entered into such a project because of their assurance of mutual benefit.

Distribution of the eighty-eight organizations above referred to by class of enterprise was: Manufacturing 66, mining 21, oil 1. There were 36 attached houses and 3484 single houses represented in the study. Of this number 263 had two rooms, 621 three rooms, 1433 four rooms, 774 five rooms, and 429 six rooms. Of the 36 attached houses, 21 provided four-room living quarters for each family. Eighteen units had double plans, two had three units in each, and one had four.

One-story houses numbered 2465, one and one-half

FIG. 3 WINNSBORO MILLS HOUSING PROJECT, WINNSBORO, SOUTH CAROLINA. BUILT 1919

story 217, and two-story 838. Wood houses numbered 3141, brick 27, and concrete (mostly stucco), 352.

Seventeen graded the main streets, 81 put down side walks at the start, 79 put down sewers, and eight contemplated doing so.

Charles F. Dingman of the Flynt Building and Construction Company of Palmer, Mass., has given some cost figures which he claims are safe for preliminary estimates on housing costs. These figures, of course, will not apply exactly to every section, but are satisfactory for a start.

Cellar floors 12 cents per sq. ft. Cellar walls of concrete 30 cents per sq. ft. Floor construction, 2 x 10 in. joist underfloor, top floor, plaster ceiling below, 42 cents per sq. ft; with no plaster ceiling below, deduct 9 cents. Walls—clapboard, sheathed, lath and plaster, 35 cents per sq. ft.; shingle practically the same figure. Pitch roof construction 11 cents per sq. ft., shingle 10 cents, asphalt 15 cents. Interior frame work plastered on two sides, 25 cents per sq. ft. Basement stairs per flight $5, straight stairs per flight $45, wide porch steps per flight $6. Porch posts $3.50 per unit, porch rails $1.25 per linear ft. Double hung windows each $10.50, interior doors each $12, exterior doors $20. Electric wiring per outlet $3.50, electric fixtures per outlet $2.50 to $10. Plumbing—bath $75, toilet $55, lavatory $35, sink $35. Steam heat per room $38, two flue chimney 8 x 8 in. $2.45.

Morgan Park, a suburb of the city of Duluth, Minnesota, is an outstanding housing project, not so much for its size but for the varied activities provided for the workers within that community. The homes are constructed of concrete, either block or stucco. Extra care has been exercised to avoid duplication of houses. Because of the varied types of workers employed there has been an equally varied arrangement of sizes and equipment of the homes. The first group of houses was completed in August 1915. The main object of Morgan Park was to house the workers for the Minnesota Steel Company; later homes have been added for The Universal Portland Cement Company and The Missabee and Northern Railroad, all subsidiaries of the United States Steel Corporation.

Early in 1918 there were employed at the steel plant approximately 3000 workers, and about 400 families were housed in the company town. Including the workers of the other subsidiaries, there were about 440 families housed there during the war period. About 180 unmarried employees were cared for at the company boarding house. About 180 were living as roomers and boarders in private families making a total of about 750 employees out of the 3500 employees upon the payroll at that time. The main result of the project has been to reduce the rents prevailing in the adjoining suburbs of Morgan Park.

All alleys have open ends and all streets are surfaced with concrete. In designing the town site an effort was made to retain all trees. The houses were not built to sell and title remains with the company. The suburb has been zoned for residences of both skilled and unskilled workers. Parks have been provided and 10 acres were upon the start set aside and donated to the city of Duluth for a school.

The dual water system is in use—one for drinking and one for washing. The first comes from springs while the latter comes from the lake. A dual system of sewers is also in use, one for the houses and the other for storm draining. Upon the start gas connections were made. All gas and water mains are laid in the alleys. The water mains are laid seven feet underground. Underground wires, ample fire hydrants, a school, a playground, a Protestant and a Catholic church, a 42-car garage and several small 10-car garages in distant parts of the city complete the equipment.

A club house and recreation grounds have been erected upon a plot approximating eight acres. This has been completely equipped by the housing organi-

zation and leased free to the Morgan Park Club. The club house has outside dimensions of 156 by 220 ft. It is built of cement stucco with curtain walls. The club house and equipment cost approximately $127,000 and the cost of the equipment upon the recreation grounds cost $26,000. The club house is equipped with gymnasium, swimming pool, and auditorium with stage. The men's club section comprises a reading and reception room. The women's club section comprises the reception and reading room and kitchen. Both sections are well adapted for Y. M. C. A. and Y. W. C. A. activities.

A separate club or neighborhood house has been erected for use of those employees living in the low rental section. This cost approximately $18,500. A modern hospital to accommodate 32 patients has been erected at a cost of approximately $70,000.

A labor camp has been erected accommodating 400 employees. This cost approximately $31,500 including all utilities and buildings. The buildings include winter bunk house, summer bunk house, club house, foremen's bunk house, dining camp, women's camp, employment office, and disinfecting room.

The kitchen is equipped with separate bake shop and in connection with the club building is a small store. There are separate bath and wash houses for foremen and laborers.

The cost of erecting row houses for low rated workers averaged approximately $400 per room. This did not include the bathroom as a separate room. Of the 42 houses erected in this group 26 contain four rooms and of the 26, 12 are heated by stove and rent for $10 per month, 14 are heated by furnace and rent for $11 and $12 per month. Fourteen of the 42 contain six rooms. These rent for $15 to $18.75 per month. There are two doubles with five rooms per family renting for $13.75 per month per family.

Three boarding houses were erected in the low wage section. These accommodate 116 boarders, 76 in double rooms and 40 in single rooms.

Eclipse Park in the northwest part of Beloit, Wisconsin, there has been laid out for the Fairbanks-Morse Company upon approximately 55 acres of ground an industrial suburb. Morse Avenue is the main thoroughfare, being 80 ft. wide. There is a 20 ft. grass strip in the center with an 18 ft. roadway upon each side. All other streets are 50 ft. wide.

The houses are set back from the street about 20 ft. The entrance square is of irregular shape approximately 260 by 150 ft. Around three sides of this square are grouped the stores, motion picture houses and other business enterprises. This space also includes a small park 145 by 115 ft.

The four-room houses have been erected upon lots 40 by 80 ft. The five-room houses have been set upon lots 45 by 90 ft. with a few upon smaller lots 40 by 80. The six-room houses have been set upon lots 50 by 100 ft. The seven-room houses have been placed upon lots varying in size from 55 by 95 to 75 by 110. At least 20 feet is left between houses. The cellars are all concrete. There is seven-ft. clearance in the cellars, eight ft. four in. on the first floors, and seven ft. nine in. on the second floor.

Living rooms average 150 to 200 sq. ft., dining rooms 100 to 140, kitchens 90 to 115, bedrooms 110 to 150. All bedrooms have two windows. Hot air is used for heating.

In some instances the dining room and kitchen is combined, in others the dining room has an alcove kitchenette 6 by 10 ft.

The selling terms are 10 per cent down upon the price of the house and the lot. This deposit obtains the deed. A first mortgage covers 50 per cent of the house. This is at six per cent payable in five years. The balance is covered by a second mortgage payable monthly.

Between Chester and Marcus Hook, Pennsylvania, is an industrial community covering approximately 20 acres for the housing of the workers employed by the Viscose Company. At the time of investigation there were 260 dwellings, two boarding houses, store, dining hall and recreation building. The boarding houses each accommodate 16.

The prevailing idea in England has been carried out at the Viscose Industrial Village. There are no less than three bedrooms, together with living room, stair hall, dining room, and kitchen. A modern bathroom is provided in each case.

Union Park Gardens, Wilmington, Delaware, was laid out in 1918-19 for the Bethlehem Shipbuilding Corporation and the Pusey and Jones Co.

It covers approximately 58 acres, connected with Wilmington by two trolley lines. The apartments and stores have been placed upon Union Street and Lancaster Avenue, near the intersection of the two streets. This permits more privacy in the residential district and diverts heavy traffic from the home section. Service alleys have been eliminated.

The space per home averages from 16 to 20 ft. frontage by 95 to 100 ft. depth. This applies to the group plans. For the semidetached and the detached the frontage averages 30 to 50 ft. The distance across the street from house front to house front averages about 80 ft. upon the narrower streets and 90 or 92 upon the wider streets. Allowing for the depth of the houses there remains a distance of about 95 ft. between rear house lines.

There are 503 houses of which 386 are group houses, 104 semidetached and 13 detached. The distribution of the land is:

Assigned to	*Acres*	*Per Cent*
Residential	35	60.3
503 house lots	32.14	....
Three apartment houses (40 apts.)	2.86	....
School	7⅔	13.2
Gardens	9/10	1.55
Streets	14.44	24.95

The density of housing calculated on the basis of 51.4 families in separate houses and 40 families in the three apartments occupying a total of 35 acres is 15.83 families per acre. Because of the extensive use of group-type houses 16 houses per acre has been possible without crowding.

Liquid Carbonic Sales Organization

Effectively Sells $8,000,000 of Product Annually

By WILLARD J. GRAHAM

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THE Liquid Carbonic Company engages in the manufacture and distribution of a complete line of equipment and supplies for the carbonated beverage industry, including carbonic acid gas, soda fountains, syrups, crushed fruits, extracts and flavors, and automatic drink-dispensing devices and bottling machinery of all kinds. In addition to the main factory and general offices at Chicago, there are some 25 sales offices, gas plants, and gas distributing stations in the United States and adjoining territory—an organization capable of rendering a complete service. The annual sales are about $8,000,000.

The general organization of the company follows rather closely the usual functional type. At the head is the president, reporting through the executive committee to the board of directors; subordinate to him are four major executives of the company, each having complete control of a principal function. These are: production manager, known as the vice president in charge of production; general sales manager; secretary-treasurer; controller. Since this article is limited to the sales function, the other departments are dismissed with this brief mention, which serves to indicate the place of the general sales manager and his department in relation to the rest of the organization.

Organization of Sales Department

The objectives of the sales department are to sell the product, to sell economically, and to control effectively the operations of the selling personnel. The whole sales organization has developed around these ideas. The control of branch managers and salesmen, advertising, the statistical section and its reports, sales order routine, etc., in fact, everything is organized to perform most efficiently the various functions incident to the selling of goods.

The central sales office is in the factory at Chicago. It exercises administration and control only. All selling is done by the branch organizations, which are separate from each other and from the central office so far as the actual selling is concerned. Even the local Chicago branch, which would be expected to be one with the central office, has its own organization, salesmen, service men and office organization, in spite of the fact that it is separated physically from the central sales offices by only a thin partition and a few inches of space. With the exception of the functions of storage and traffic, which are performed for a fixed charge by the central factory organization, the branch at Chicago is as separate and distinct as the ones at New York or Dallas.

The entire domestic market is divided territorially into approximately 125 divisions. The basis of the division is primarily population. So far as practicable about one million population constitutes a territory. Exceptions are at the extremes. Very large cities contain more than one million people but are not usually subdivided. Some thinly populated sections of the country constitute territories with fewer than one million people. With the exception of the large cities one salesman covers each territory.

Territorial Organization

These territories are grouped in 12 branch districts with a large city as the center. At this branch city is located a sales office, a gas plant, and usually a warehouse and showroom. The size of each branch depends upon the city and the territory in which it is located. In addition, there are five sales offices, consisting of perhaps a showroom with a salesman in charge. Also, in some territories are distributing depots for gas, where shipments may be made from the various plants and there stored available for instant use. The particular characteristics of the gas demand make this advisable. There are at present 14 of these depots.

Branch offices and gas plants are located in Chicago, New York, Kansas City, Boston, Philadelphia, Atlanta, St. Louis, Dallas, Minneapolis, Cincinnati, and Pittsburgh. Gas distributing depots are located in Denver, Salt Lake City, New Orleans, Portland, Milwaukee, Detroit, Indianapolis, Rochester, Baltimore, Washington, D. C., Charlotte, Columbia, Jacksonville, and Birmingham. More or less extensive sales offices are in San Francisco, Los Angeles, Seattle, Nashville, and Phoenix. At Memphis there is a gas plant and sales office, subsidiary to the gas plant in St. Louis.

These branch organizations are primarily selling units. All of the manufacturing, with the exception of the gas, is done at the central factory in Chicago, and the finished product may be stored either at the factory or at the branch. All selling and billing is done by the branches. If a customer wants to change his order, or has a claim or complaint to make, he usually approaches the factory through the branch manager rather than direct.

The 12 branches are each controlled locally by a

branch manager who reports directly to the central selling organization at the main factory. In charge of this central or general sales office, is the general sales manager. He supervises directly the manager of gas sales, advertising manager, statistician, and assistant sales manager, and somewhat less directly through this assistant, the head of the extract sales, head of machinery sales, and branch manager and his salesmen.

The General Sales Manager

Thus the general sales manager controls very definitely and effectively all the activities of the sales department. Very little is done in the sales office or at the branches without his approval and sanction. The statistical department compiles reports and graphs in accordance with the information desired by him. The advertising manager submits all plans and copy for his approval. All sales planning, sales campaigns, advertising campaigns, etc., originate in his office. He confers with the branch managers on the employing of salesmen, and approves all salesmen's contracts. He is the major factor in the choosing of the branch managers, though these are nominally chosen by the executive committee. He employs all the sales office force. In short, he controls *all* the activities of the sales department.

Reporting directly to the general sales manager is an executive known as the gas sales manager. Due to peculiar problems in relation to the gas situation, he is located in New York. There are more gas sales there, and he is in a better location to handle the price problem, which is an important element in the selling of gas. His chief duties are watching competitors' prices, changing his own prices and generally supervising the selling and delivering of gas to the various types of purchasers.

The Assistant Sales Manager

Also reporting directly to the general sales manager is the assistant sales manager. The work of this executive may be divided roughly into two general divisions. First, he has charge of the sales order department which does the routine office work in connection with a sales order from the time the order is received until the goods are shipped. This order department, and especially the assistant sales manager, furnishes the contact between the factory divisions and the branches. Second, he is in very close contact with the branch managers and salesmen. Frequent reports from and letters to the managers and salesmen foster co-operation with the sales force, result in friendly relations, and furnish an effective means of control. Frequent contests, annual conventions, etc., build the morale of the sales force.

Special Sales Executives

There are in the sales department two special sales executives: the head of machinery sales, and the head of the extract sales. They are essentially sales managers of their respective lines, but at the same time are closely connected with the manufacturing divisions, the head of extract sales being also the superintendent of the extract manufacturing division. These men are made necessary by the special nature of their respective products. Sales of extracts depend primarily upon a demonstration to the prospective customer that certain extracts can be combined to form desired flavors, etc., and this is essentially the work of a chemist. For this reason there are special extract salesmen who carry, as it were, traveling laboratories, to demonstrate to the customer the possibilities of the product. These special salesmen report in a functional way to the head of extract sales, but are at the same time under the complete line control of the branch manager and the general sales manager.

The problem of the head of machinery sales is a little different. When machinery sales are made to bottlers it is sometimes necessary to draft a layout of the equipment, and this is the work of the head of machinery sales and his assistants. He is an engineer and a draftsman, but his work is essentially in connection with the sales department. He has some special salesmen who report to him in much the same way as do those to the head of extract sales described above.

The Branch Manager

The branch manager is perhaps the pivotal point in the organization of the sales force. Since all the selling is done by the branches, and all contact with the customers (except the collection of contract accounts and of some other accounts by the credit department at the central office) is through the branches, his position is an important one. He is in direct line control of all salesmen and of all other employees at the branch. The reports of salesmen that go to the two higher executives are usually summaries and totals of the reports that go to the branch manager, and come through him. In all cases direct line interference or control must be exercised by, or at least through, the branch manager.

It should be noted, however, that some of the general executives of the company exercise some functional control over employees at the branches. For example, the traffic manager at the central office institutes the general procedure for the traffic man at the branch in his handling of receiving and shipping, and trucks. He gets frequent reports on the trucks, etc.; but the direct line control, the "hire and fire," if it might be so termed, lies with the branch manager. The same holds true with the other employees. The gas manager and the gas plant engineer are in some degree under the functional control of the general gas manager. The branch cashier and credit department are to some extent controlled by the central finance department. The stores keeper gets his methods from the head of general stores at the factory. Others might be mentioned, but in every case it is the branch manager to whom they are directly responsible, and who in turn will be held responsible to the general sales manager.

Branch managers are selected by the general sales manager, in consultation with the executive committee. Their past record in salesmanship, personality, apparent ability in organizing and handling men are among the factors considered in their selection.

Sales Research and Planning

There is no formal centralized research department but the function is necessarily exercised. It might be said that in an informal way the general sales manager and heads of the sales divisions act cooperatively in matters of exploitation of new territory, introduction of new products, etc., and in cooperation with the enginering departments of the various manufacturing divisions in the matter of changes of design to improve the efficiency or salability of the product. Both of these factors, and the additional one of the relative ease and expense of manufacture, enter into any change of design.

In all cases the suggestions of salesmen and branch managers, who are in closer contact with the customer than the executives at the central office, would be given some weight in arriving at any decision affecting any of the above proposed changes. This lack of centralization of this particular function is due, probably, to the great variety of products manufactured and the enormous territory covered. There are so many varying factors affecting each that a central department has not been deemed advisable, especially since a recent experiment along that line failed.

Classes of Customers, Orders, and Terms

It is the policy of the company to sell both direct to the customer and through jobbers. With the exception of CO_2 gas, the importance of the jobber is decreasing, the company sells most of its other products direct. The reason for discontinuing relations with the jobber lies in the fact that sales by the jobber of the larger units of product, such as soda fountains and bottling machinery, require considerable attention and service from the regular salesmen, and the profit on the transaction is of necessity much less. This has resulted in a conviction that the sale might better be made direct and the entire profit secured for the company. Therefore, except in some exceptional cases where a jobber can secure additional sales to which the company would not have access, a growing proportion of the sales are being made direct and the jobbers are being gradually "dropped," so far as the large units of products are concerned.

An entirely different policy is followed in the case of gas, which is one of the chief products. Here immediate delivery is very important, and outside of branch cities where deliveries can be made by the company's own trucks, most of the sales are made through jobbers.

All orders received classify under one of three heads: Gas orders; general merchandise orders for fruits and syrups, miscellaneous supplies, etc.; and contract orders. Over one-half of the business of the company is in this last type, and there are features of special interest in connection with it. These orders are for soda fountains and bottling machinery, and are paid for on the installment plan, the title, of course, remaining in the company until all installments are paid. The credit routine, terms of sale, and method of enforcing insurance by the customer are of interest.

The terms on a contract order are a certain amount in cash, usually 25 per cent, the balance to be covered by notes and paid in monthly installments over a period not exceeding 24 months. An exception to this rule is in the case of "spring-dating orders." These are taken in the autumn and winter months with the agreement that the goods will not be shipped until the first of April, or at least that the time of sale will be considered to be the first of April. On these orders a smaller amount is accepted as the initial payment, usually 10 per cent, and the balance of the initial payment is not due until April 1, at which time the remaining 15 per cent is paid and the installments and notes begin on that date as though the order has been actually sold at that time. This sales device is to lessen the peak periods of manufacturing activity.

The "Blue Note"

All contract orders are sold under the provision that the customer must insure the apparatus and keep the policy in force during the life of the contract. To emphasize this requirement and assist in enforcing it, it is required of all who buy apparatus on time payments to sign a "Blue Note," made out in favor of the company and payable when due if insurance on equipment is not procured. The name means nothing, and because of this it is preferable to an "insurance note," for this might lead the customer to think that the note provided insurance, which it does not. It only releases him from the obligation to carry insurance and gives him the right to carry the risk himself. When the apparatus is insured and the policy, made out in favor of the company, is forwarded to them, the blue note is cancelled. If the policy is not received, the blue note must be paid when due. This is a very effective way of being sure that all apparatus out on contract orders will be covered by insurance. The receipts from any blue notes that are paid are held in a reserve account to pay for losses on apparatus that is not insured and is destroyed.

Sales for Export

A considerable quantity of the products of the company is exported each year, and these sales demand some special organization. In the past a few foreign branches have been organized but have been discontinued. All of the export sales go through the hands of the export sales manager at New York, though provision is being made, since the discontinuance of the Toronto branch, to handle sales into Canada through the Minneapolis and Chicago branches.

The reason for the special organization is that there are peculiar problems that arise in connection with export sales. If they go by water, special packing is required. Various shipping documents must be se-

cured. Risks of loss in transit must be protected against through insurance. There are problems of duties, exchange rates, increased credit risks, etc. For this reason the handling of these sales has been centralized to permit a greater degree of specialization in the knowledge and experience necessary for efficiency in taking care of this class of transactions.

Sales Information Manual

A sales manual is placed in the hands of every salesman. To insure that he cares for it, a charge of $50 is placed against him and cancelled when the manual is returned.

In general the manual includes a general description of the details of manufacture of the complete line of products, descriptions of materials used, selling information, general instructions to salesmen. Some of the subjects covered indicate the contents:

Story of the Birth and Growth of the Liquid Carbonic Company.
A Prediction for the Future, by the President.
What a Salesman Should Know about Credits, by the Credit Manager.
The Value of Good Will, by the General Manager.
Photographs and Descriptions of the Various Operations.
Weights of Products, Crated and Ready for Shipment.
A Description in Detail of all Products Manufactured.
General Instructions to Salesmen:
- Equipment.
- Daily reports.
- Handling of prospect.
- Orders.
- Settlements.
- Soliciting orders.
- Terms.
- Contracts.
- Guarantee.
- Why a promise isn't an order.
- The "Blue Note."
- Cooperation with the Credit Department.

Sales Conventions

Conventions are of two general kinds. First, the annual convention of branch managers at Chicago. In attendance at these meetings, games, banquets, etc., are the general officers of the company, higher executives, especially of the sales department, and all the branch managers. The object is to discuss problems, make plans, and get inspiration.

Annually at each branch there is held under the management of the general sales manager a convention of all the salesmen in the branch district. The object of this convention is the same as the first. Results have justified the expense incurred in connection with these affairs.

Each year, under the direction of the general sales manager, a month's course in the selling of the company's products is given to aspiring salesmen. It consists of lectures, exercises, quizzes, and visits to the manufacturing divisions. The results of these courses have amply justified them, as the sales of the "graduates" compare very favorably with those of experienced salesmen.

Contests Among Salesmen and Branches

Various minor contests are in progress much of the time. A week is given over to a drive on the sale of some particular commodity and prizes are awarded for the largest sales for the week. For example, there might be a Fruit and Syrup Week, a Soda Fountain Week, an Extract Week, etc. In every case the result is increased sales of the other commodities.

To get rid of slow-moving stock or semi-obsolete stock, additional commissions are given and special prices made to customers. This results in a surprising number of sales. Lists of such items are being continually mailed to the salesmen by the assistant sales manager, and their cooperation asked. Second-hand outfits taken in trade are often disposed of in the same way.

The president's cup contest is a continuous affair. The former president of the company donated a large silver loving cup to go each year to the branch which shows an increase of sales in the greatest number of commodities. For this purpose there are ten major commodity groups. The cup is re-awarded each year, though of course it might remain in the same branch a second year.

The most pretentious of all the contests is what is known as the Fifty-Two Club contest. It originated in a contest started by the general sales manager a few years ago to see who could get the most contracts in a certain length of time, four weeks, I believe. The idea was so good and the results so satisfying that the idea was made the basis of a continuous contest. The requisite for membership in the Fifty-Two Club is the securing of fifty-two contracts a year, an average of one a week.

This year the prize is a trip to Chicago for each member, and entertainment for four or five days at the expense of the company, and the salesmen are working their heads off to make good. A contract a week is the goal, but many do more than this, some selling as high as 100 in a year, an average of about two a week. The one who sells the highest number automatically becomes president of the club. A large card in the general sales office contains the names and standing of last year's members. The record cards of the members have a special design, the same as is on their pins. Letters are written to them frequently telling them just where they stand and what they have to do to qualify, and it certainly does make them work.

This plan seems to work much better than any variation of the orthodox point system. The records of sales are absolute proof of effectiveness, as there is no question about the reason for the increased sales in contract orders. This plan, and others, and the cooperation of the sales office with the salesmen and branch managers in other lines, have resulted in marked loyalty of salesmen and managers to the central organization.

Performance Data On Belting

Its Purchase and Installation, and Methods of Obtaining the Power Consumption of Machinery *

By W. W. NICHOLS

Mechanical Engineer

RESPONSIBILITY for factory belting is usually left largely in the hands of employees who have received very little, if any, instruction in the correct methods of its application and care. Hence, belts of too light weight are often installed, and to make them drive they are put on at an excessive tension. As a result, the loose pulley, or clutch pulley, bearings wear excessively.

While these bearings are being repaired, the machine is unable to operate, and there is an unnecessary loss of production. The possibility of this loss is rarely taken into account when belts are being purchased. The buyer considers mainly the original cost of the belt, rather than the duty which it is required to perform, and generally buys the lowest priced article on the market. Then a few bearings are ruined, or the belt stretches, and machines must stop while the damage is repaired or the belt is shortened.

Another source of trouble is that the most suitable type of belt for the work may not be purchased. The use of heavier weight belts from the main shaft or jack shaft to countershaft is an improvement needed in many plants. It is most strongly recommended as a means to overcome friction losses, due to tight belts, and to avoid subsequent maintenance charges.

When belting is purchased to specifications, it is not checked against such specifications in many cases, upon its receipt at the works. Belts cut from these rolls and put into service, shortly afterward develop defects of material or workmanship. Another piece is then cut to replace the defective one, which is thrown into the scrap pile at considerable loss.

Shop Complaints Should Have Attention

Instances have come to the writer's attention, where the men handling such belting in the works have complained to the purchasing department of the quality of the material which was received, only to be told that the purchasing department knew what they were buying and the works had to use it. It is very evident that, where such a policy is permitted, plants are not being run upon an economical basis and are entirely lacking in cooperation between their various departments.

Another cause for high maintenance costs of belting is the poor types of belt shifter forks furnished with many machines. Where roller shifter forks are used, a material saving can be effected. A sketch of the type adopted by the writer is shown in Fig. 1. The stud is drilled with a ⅜ in. pipe drill, the slot cut into this hole being ⅛ in. or 3/16 in. wide and of a length equal to the length of the roller. The hole and slot are packed with cup grease before putting the roller in position. A washer and nut are placed over the end of the roller, and when long forks are necessary, a tie plate is placed between the washer and the

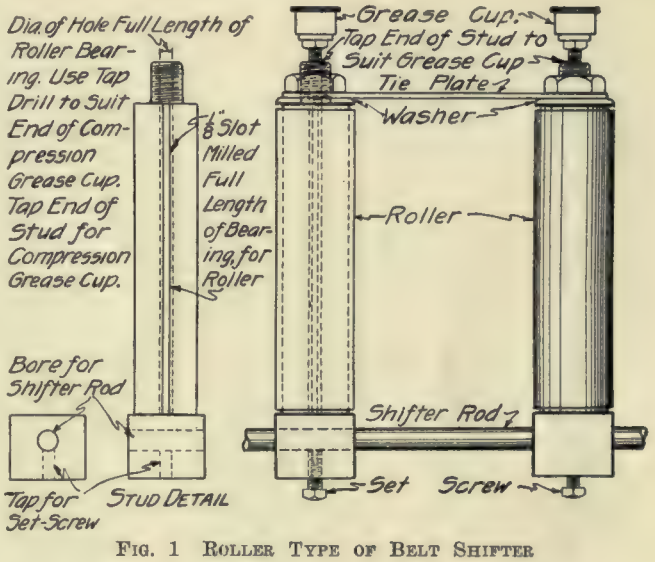
Dia. of Hole Full Length of Roller Bearing. Use Tap Drill to Suit End of Compression Grease Cup. Tap End of Stud for Compression Grease Cup.
⅛ Slot Milled Full Length of Bearing for Roller
Grease Cup.
Tap End of Stud to Suit Grease Cup
Tie Plate
Washer
Roller
Bore for Shifter Rod
Shifter Rod
Tap for Set-Screw
Stud Detail
Set Screw

FIG. 1 ROLLER TYPE OF BELT SHIFTER

nut to prevent springing of the forks. A grease cup is placed in the end of each stud. By this method, perfect lubrication of the rollers is obtained, no matter at what angle the forks are placed.

The writer was called in consultation by one of the largest automobile manufacturing companies in America, to assist in making a belt survey in their plant. He suggested using an electric recording wattmeter to obtain diagrams of the actual power consumed upon various types of machine tools, and ascertaining the cubic inches of metal removed per minute per watt, this data to be tabulated for future reference and use when similar classes of work were in progress. Figs. 2, 3 and 4 show diagrams taken during this study from a punch press, a Norton grinder, grinding cam shafts, and a boring mill. These diagrams furnish the best possible method of checking previous time studies, as well as showing the friction load of the machines when running idle.

In Fig. 2, taken from a punch press, each group of lines represents operations upon a strip of metal, each

* This paper was prepared by the author and delivered before the First International Management Conference, held in Prague in July, 1924.

line representing a blank which has been punched. The distance between these groups represents the time consumed in changing the strips. Some of the groups representing the strips are irregular. This irregularity was caused by difficulties which the operator had with the material—in some instances he was not able to procure the maximum number of blanks from the strip.

When these tests are run for a whole day, the number of blanks produced upon a machine, the unnecessary loss of time in changing strips, the power required to drive the machine, and the maximum power required to perform the work, can all be readily determined from the resulting diagrams.

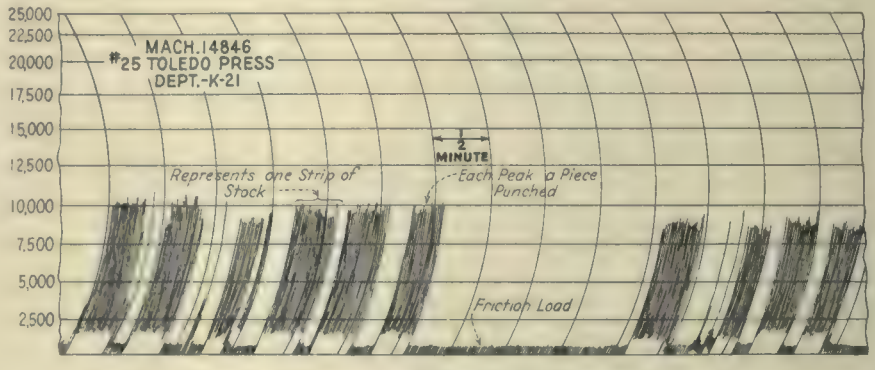

FIG. 2 RECORDING WATTMETER DIAGRAM OF PUNCHING OPERATIONS

Power on Norton Grinder

Fig. 3 is taken from a Norton grinder working on cam shafts for automobiles. It shows very distinctly the effect of the grinding wheel taking an excessive cut, as represented by the two longest curves at the right of the diagram. Curves obtained by this method show the power which is consumed and for which it is necessary to belt up the machine. This data is unobtainable by general methods of inspecting the operation of a machine, and lack of it results in under-belting the machine, with consequent slipping, and loss of production.

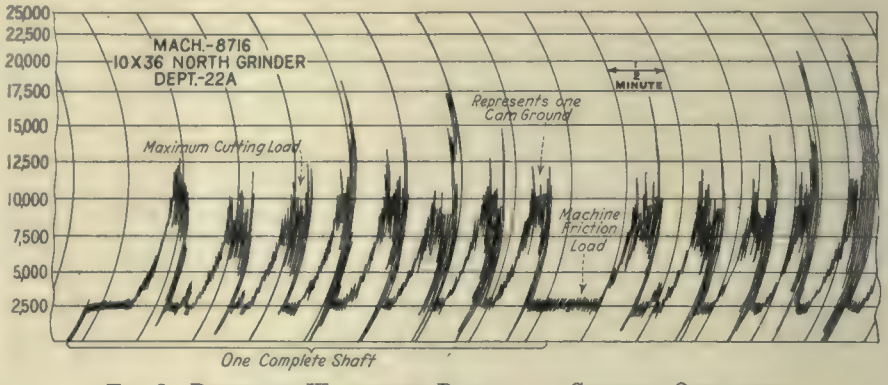

FIG. 3 RECORDING WATTMETER DIAGRAM OF GRINDING OPERATIONS

Fig. 4 shows the power required for each of the various operations on a boring mill job. Should it be desirable to show these operations in greater detail, the rate of travel of the diagram can be increased to, say, 3 in. per minute.

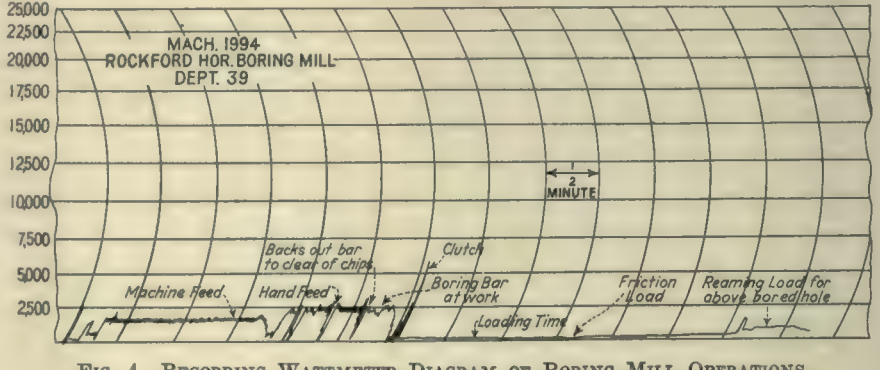

FIG. 4 RECORDING WATTMETER DIAGRAM OF BORING MILL OPERATIONS

To enable the Easterline recording wattmeter employed to be used upon machines belt-driven from a main line shaft, a 10 hp. motor was mounted on a lift truck platform and the motor pulley was changed, as required, to give the correct speed to the countershaft of the machine to be tested. The belt from the main line to the countershaft was then thrown off and the motor belted direct to the receiving pulley of the countershaft. A desk was constructed at the opposite end of the platform and upon this the wattmeter was mounted. It was also found advisable to place a weight of about 400 lb. underneath the desk to maintain the stability of the apparatus. A flexible cable was used between the motor and nearby outlets to carry the current to the motor on the truck platform.

When such equipment is used to test machines fitted with direct motor drive, it is necessary only to connect the instrument directly to the motor mounted on the machine.

The assembled apparatus can be moved up to any machine for testing purposes without the bother of setting up individual units each time a test is run.

This outfit can also be used to make tests of various high speed steel tools to determine the life of these tools. The diagrams will show the length of time the tool will operate successfully, the exact point at which it begins to break down and how long it is possible to use it after it starts to fail.

By comparing the diagram from a new tool with others obtained after successive grindings of the tool, it is possible to determine when regorging will be necessary, so that economical results may be obtained.

These suggestions outline only a few of the uses to which the equipment can be put, but it is hoped they open the way for many other applications.

The Modern Manufacturing Plant

New Plant of The Hall Planetary Company Represents Marked Advance in Lighting, Heating and Power Transmission

By J. R. THOMAS

Treasurer, The Hall Planetary Company

IN order to get away from an industrial neighborhood which, through a period of years, had become unsuited for our type of manufacturing because of fumes and unpleasant odors from nearby plants, The Hall Planetary Company in 1924 decided to move to a more favorable locality. Before any definite steps were taken in this direction, a very careful survey was made and many machine tool plants were visited to determine the best site and layout for a new factory.

It became evident that production was greatly facilitated by locating a factory on somewhat high ground, where there was good air, and away from a water front. For many reasons, chief among which were accessibility to sources of supply and to markets, and convenience of transportation facilities, we desired to keep our plant within the city of Philadelphia instead of moving it to a smaller town. Hence, an altitude map of the city was procured and various sites suitable for manufacturing purposes and located on high ground were investigated. Finally a growing industrial locality made up of modern plants, toward the northern part of the city, 250 ft. above sea level and convenient to the Pennsylvania and Philadelphia and Reading Railroads, was picked out.

FIG. 1 NEW PLANT OF THE HALL PLANETARY COMPANY

Adequate light was the first factor to be considered in designing a new building, as our product is one of high quality and requires expert and careful workmanship. We therefore consulted an eye specialist who had made extensive research into lighting from the standpoint of its effect on the worker. He recommended a daylight type of building, the major portion of the roof and walls to be of actinic glass, which has an amber tint. This glass, on account of its properties, excludes 85 per cent of the ultra-violet rays and 55 per cent of the infra-red or heat rays of the sun. By actual government tests it has proved so satisfactory that it is being used in various ways where glare and eye strain are objectionable. The manufacturers of this glass were therefore consulted and a design worked out to utilize their standard sizes of product. See Fig. 1.

We then laid our plans before the construction firm which was selected to fabricate and erect the steel framework for the building. Steel construction was selected because it was cheap, convenient to put up, was adapted to the daylight plan of structure, occupied the least space, offered the least interference with interior lighting and traffic, and provided most readily for the installation of shafting and equipment.

The building thus constructed is 100 x 150 ft. in extent on a property 280 x 500 ft. in area. It consists of two 50 ft. wide spans. The roof trusses are A-frames at 9 ft. 5 in. centers, and the roof is of ridge construction. The back end of the present structure is enclosed with corrugated iron sheeting. At a later period as the business expands the building will be extended back another 250 ft. and this partition will be removed. Further growth is provided for on the present plot, as there is room for another building 100 ft. wide and 400 ft. deep alongside of the first one.

The bottoms of the trusses are 12 ft. above the floor level. All countershafting is supported on the tops of these lower chords, thus leaving the space below clear of obstructions. Trusses were spaced twice as close together as was required from the standpoint of build-

ing strength, because the plan of material handling worked out involved the use of these trusses to carry cranes and hoists, as well as to give support to line and countershafting.

In place of the usual I-beam and angle type of construction, the trusses were made entirely of channels, each member consisting of two channels placed back to back with a 1 in. space between. All equipment supported from the roof trusses in any way is held in place by T-bolts passing through the spaces between channels. Hence, shafting and any equipment can be adjusted, or taken down and re-located, in about an hour's time at the most, instead of taking several days and entailing a loss of production, as is usually the case.

The 12-in. brick walls of the plant extend 30 in. above the floor level. From this point up the walls are entirely of glass. Shop benches range in height from 32 in. up, and therefore are higher than the brick portion of the wall. When a man has to take an accurate measurement on a piece of work in one of the bench vises he can stoop down and do so against the light, obtaining very accurate readings without removing the work.

The glass used is wire-inserted, except in the sash ventilators and partitions. In the main part of the side wall sash and in the roof it is corrugated. In the ventilating portions of the sash, which are located only in the side walls, flat clouded glass is used. All of the glass has the amber color characteristic of the actinic variety. The corrugated sections are 28 in. wide and are mounted vertically in the frames, the lower row being 63 in. high (with 3 in. overlap) and the upper row 54 in. high. The ventilating sashes each have twelve 14 x 20 in. panes, and are hand-operated. Sash mountings are all of copper and hence will last indefinitely without painting or other maintenance.

The permanent end of the building toward the street has glass in the rectangular portion up to the roof trusses and above this is enclosed with heavy corrugated asbestos board of a weatherproof nature.

The roof of the plant is almost entirely of glass, which extends from the ridge down to within about 4 ft. of the valley or gutters. The lower portion is of slag type—wood base with tar paper and tar and gravel coating. All gutters, valleys, ridge-poles and the upper parts of leaders are of copper to reduce maintenance costs.

Measurements taken of the daylight intensity within the shop show it to be 500 ft.-candles along the windows and 400 ft.-candles back in the darkest portion of the building. See Fig. 2. This is an exceptionally high intensity but the actinic glass removes all glare, and at the same time produces no deep shadows but only those of sufficient quality and distribution to make vision easy. The steel work, underside of gutters, interior brick work, and partitions are painted a buff color to harmonize light reflected from them with that coming directly through the glass.

Artificial light for winter afternoons and for any night requirements is supplied by 200-watt lamps in reflectors painted white inside and green outside. These lights are placed at 15 ft. by 9 ft. 5 in. centers, and hang 11 ft. above the floor. Lighting intensity is well above 10 ft.-candles.

The floor of the shop has a 6 in. concrete base on which are set wood blocks. Special care was taken in laying these blocks to insure an even surface to make them easy for trucking. In order to provide for the special type of heating system installed, and also to do away with radiation which takes place from the foundations of most buildings, and causes the floor to be cold to stand on for a distance of about 15 ft. back from the walls, the floors in this case were constructed as islands separate from the building. See Fig. 3. The 3 and 4 ft. wide ducts thus provided form channels for the passage of warmed air used to heat the building. Water and drain pipes also run through these ducts and although concealed are readily accessible.

FIG. 2 ALL PARTS OF THE PLANT HAVE EXCELLENT DAYLIGHT

Partitions between the main shop and the washrooms and heater room are of brick and glass like the outside walls, except that the glass is actinic clouded. Between the shop and the office there is an asbestos board partition, double to deaden sound.

The building is heated by means of hot air passed through the concrete ducts surrounding the floors, as above described. Two large heaters are installed in the heater room shown in Fig. 3. These have a capacity of 24,000 cu. ft. of air per min., 50 per cent in excess of what has been estimated as sufficient for the present

building. Six changes of air per hr. can be made. The air is heated by means of oil burners, and close control can therefore be maintained. A large fan, drawing air either from outside the plant, or from the plant itself when the condition of the air warrants recirculation, forces this air through the heaters and into the concrete ducts. The ducts are fitted with galvanized covers making them practicably air tight. Over these 2 in. planking is laid on a level with the wood block floor. Mushroom type outlets, 18 ft. apart, and on both sides, in the center and at the ends of the building, rise from the heat ducts, as in Fig. 3.

Each of the outlets is equipped with a shut-off so that the heat is always under local control, and can be distributed where needed. Air leaves the heater at 120 deg. fahr. and the percentage of humidity can be regulated for the greatest comfort. In the summer the fan and air ducts are used to circulate fresh air and help keep the shop cool.

The daylight construction of the plant, with its unusual amount of glass area, did not make the building warm during the last summer. In the winter it is anticipated that not much more heat will be radiated from the building than from one of less window area; but even if radiation is greater, the cost of the extra heat necessary will be insignificant compared to the many advantages from a production standpoint which are obtained from the daylight construction.

Ventilation is provided by means of 10 roof ventilators placed at 20 ft. centers along the two ridges of the roof. See Fig. 1. These ventilators are each 36 in. in diameter. They are intended to produce four changes of air per hr. in the plant in a 10 mile per hr. wind. Each can be shut off independently.

Power is obtained from a two-cylinder 100 hp. Diesel type engine, which investigation showed to be the most economical equipment for the purpose. This engine operates an air compressor feeding into a 300 lb. per sq. in. tank in the yard to provide starting power. On a rough test the engine has delivered 30 hp. on 10 to 12 gal. of 28/34 test fuel oil and 2 to 3 qts. of lubricating oil per day of 9½ hr., at a cost of around $1.25 per day for these oils. When once started, the engine operates itself automatically, leaving the engineer free for plant maintenance work, such as oiling shaft bearings, filling oil cans for machines, etc.

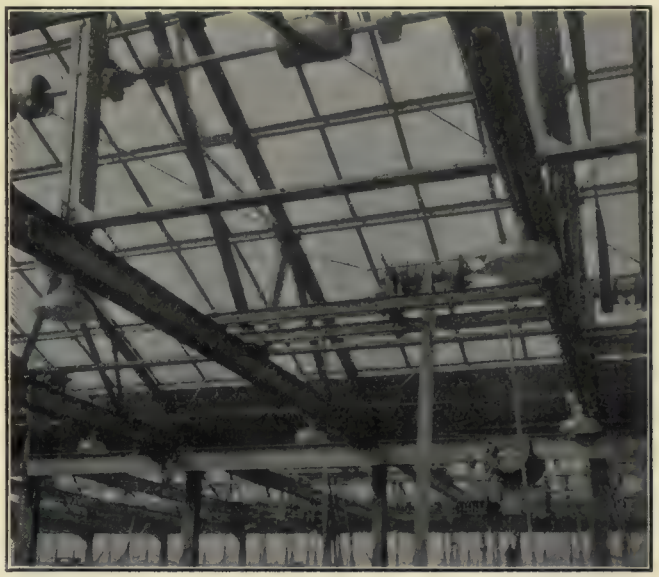

FIG. 4 METHOD OF SUPPORTING LINE AND COUNTERSHAFTING

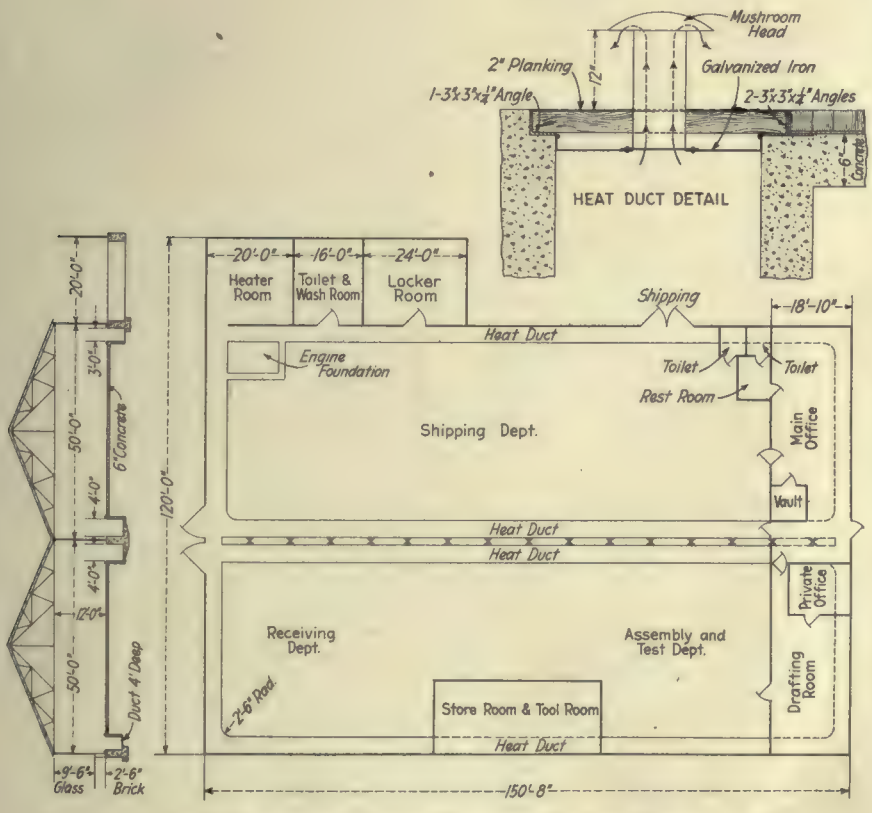

FIG. 3 GENERAL LAYOUT SHOWING HEATING DUCTS

The engine drives a 48 in. diameter balanced clutch pulley at 270 R.P.M. A 15-in. double leather belt 62 ft. long transmits the power to the line shafting. The engine also operates a 25-kw. 110-volt D. C. generator furnishing current to the lighting system and also to a few machines operated by direct drive motors.

Line shafting is supported in post-frame bearings attached to the uprights of the roof trusses by means of T-bolts extending between channels. See Fig. 4. Countershafting is carried on stringers extending between roof trusses and supported on top of the 10-in. channels comprising the lower chords. These stringers consist of 4 in. channels in pairs, back to back, with a space between. They are fastened to the trusses by T-bolts passed between the adjacent channels. Shaft hangers are carried on top of the stringers and are likewise clamped by T-bolts.

The material handling equipment

is arranged to operate like a railroad with main lines and branches. The two main line tracks consist of 12 in. I-beams running lengthwise of the shop and fastened to the roof trusses by special clips and adapters. The branches serving the machine tools are the lower chords of the roof trusses. Hoists with trolleys run on the 12 in. I-beams and directly on the channels composing the lower chords of the roof trusses. Where motion in more than one direction is required, as in assembling, short bridge cranes, spanning trusses, are employed.

Two hand lift trucks and a set of platforms comprise the remainder of the material-handling equipment.

The combined storeroom and toolroom is enclosed by a partition made of wire mesh on steel angle frames. Sectional steel shelving has been installed for the storage of many of the tools and supplies. For small parts, special boxes, or drawers, with galvanized sheet sides and bottoms and wood ends, have been provided. These boxes are 6 x 6 x 12 in. in size and are made to fit in sections of the steel shelving.

To hold tools such as drills, taps, reamers, milling cutters, etc., special easels have been built and are placed handy to the toolroom issuing windows. These easels consist of steel frames holding 2½ in. wood planking drilled with holes to receive the shanks of the tools in question. The wood planking is inclined so that the tools will not fall out, and beneath each tool is lettered its size in white letters on a black field. Hooks on the ends of these panels are provided to hold workmen's checks when the tools are issued.

The wash room is equipped with circular multiple type wash fountains. Toilet installations are of white porcelain. The closets are of the frost-proof automatic flush variety and are enclosed by steel partitions set about 12 in. above the floor level. A locker room adjoins the wash room.

Drinking fountains are of the pedestal bubbler type with cooling attachment. City water is used for drinking and sanitary purposes.

For fire protection, sand and water pails have been installed. A city alarm box is convenient in case of an unexpected conflagration. Plant and product are fire-proof, and fuel and lubricating oil form no fire risk, as they are stored in a separate steel building.

Safeguards have been provided around all dangerous parts of machinery. They consist of perforated metal on steel frames. First aid cabinets furnish a means for taking care of all but very serious injuries.

A time-recording clock system for in and out records, and for keeping time on jobs in ⅒ hr. units, is used. This clock is also used by the night watchman to ring up his half-hourly rounds.

TABLE 1. SUMMARY OF DATA ON HALL PLANETARY PLANT

Location	Philadelphia, Pa.
Construction	Single story. Steel framework with brick and glass enclosure on front and sides. Rear end is temporary, and built of United Alloy Steel Co. Toncon corrugated sheet. Steel work designed and erected by Belmont Iron Works. Johns-Manville corrugated and waterproofed asbestos board used in triangular section of front end.
Grounds	Trees and lawn along front.
Property	280 x 500 ft.
Fence	Cyclone type—wire mesh on steel framework.
Building	100 x 150 ft. Two 50 ft. spans. Total height to ridge pole 22 ft. To be extended later to a depth of 400 ft.
Floor Area, Shop	13,200 sq. ft.
Architecture	Daylight construction.
Neighborhood	Modern industrial community.
Employees	At present about 40.
Transportation facilities	Auto truck service.
Entrances	Front for office. Side and rear for shop.
Walls	Brick, 12 in. thick, to a height of 30 in. Above this glass to a height of 12 ft. total. Rear wall is temporary galvanized iron enclosure.
Windows	Glass enclosure above brick wall consists of ventilating sashes 63 in. high in steel frames. Corrugated glass above and between the sashes. Mountings are of copper. Heater and washrooms have steel sash in smaller sections.
Glass	Pennsylvania Wire Glass Co. make. Corrugated, actinic wire glass (28 x 63 and 28 x 54 in. in size) between ventilating sashes and in roof. Ventilating sections, and sash in heater and wash rooms have flat, amber clouded glass, 14 x 20 in. panes, without wire insertion. Daylight intensities, 500 ft.-candles at windows and 400 ft.-candles in darkest portion of shop.
Doors, exterior	Wood, tongue and groove construction. Front office door has upper panel of glass. All doors swing outward.
Doors, interior	Wood. Those between office and shop have glass panels. Rest are all wood.
Roof	Steel trusses, of channel members, at 9 ft. 5 in. centers, supporting amber, corrugated, wire-inserted glass extending from the two ridge poles of each span down to within about 4 ft. of the gutters. Remaining section is slag roofing—wood base with tar paper and tar and gravel coating. Ridge poles, gutters and upper parts of leaders are of copper. 12 ft. clearance under trusses.
Ventilation	Roof ventilators 36 in. in dia. mounted along each ridge pole at 20 ft. centers. Side-wall sashes have ventilating sections of twelve 14 x 20 in. panes, hand operated by bar and pin mechanisms.
Painting	Walls and all interior steel work painted buff to preserve the lighting effect of the glass.
Floors, office	1-in. maple laid on 2 x 3-in. timbers at 2 ft. centers on concrete base.
Floors, shop	Southern Wood Preserving Co. 2½ in. creosoted pine block laid on end on 6 in. concrete base. Wash rooms and locker room have all-concrete floors, draining to center.
Partitions	Between shop and office there is a double partition of asbestos board on wood framework. Between shop and wash rooms and heater room partitions are of brick and glass. Storeroom partitions are wire mesh on steel frame.
Lighting	Green and white Benjamin fixtures at 9 ft. 5 in. by 15 ft. centers, 11 ft. above floor. 200-watt Mazda bulbs. Intensity well above 10 ft.-candles.
Heating	Fan blast hot air system, American solar heat generator type, made by American Heating and Ventilating Company. Johnson oil burners. Regulated humidity, 65 to 70%. Fresh or recirculated air supplied. Two heaters with total capacity of 24,000 cub. ft. of air per min., delivered air at 120 deg. fahr. Six changes per hr. Hot air blown through ducts of concrete and galvanized iron surrounding and below the floor. Outlets of mushroom type with local shutoff control. Fan and ducts circulate air in summer for cooling.
Power facilities	100 hp. 2-cylinder Deutz (Diesel type) oil engine driving 48-in. balanced clutch pulley at 270 r.p.m. A 15-in., 62-ft. long, double-ply, leather belt transmits power to line shafting. Engine also drives 25 kw., 110 volt Crocker-Wheeler D.C. generator for lighting and certain motor drives. In addition, it runs a compressor (300 lb. per sq. in. pressure) to store up air in yard tank for starting purposes.
Fuel handling	3000-gal. fuel oil tank in outside building stores oil. A day's supply at a time is pumped into service tank in shop.
Compressed air	Ingersoll-Rand compressor, 92 cu. ft. displacement, 100 lb. pressure.
Line shafting	Carried on post frame hangers equipped with Hyatt roller bearings. Hangers held to upright members of roof truss by T-bolts.
Countershafting	Supported on stringers spanning roof trusses and attached by means of T-bolts for facility in erecting and relocating.
Water supply	City system at 20 lb. pressure.
Cranes and hoists	Alfred Box Co. make, running from 1000-lb. to 3-ton capacity. For crosswise travel of the shop the hoists run directly on the lower cords of the roof trusses, and the cranes span the distance between trusses. For lengthwise travel, two systems of 12-in. I-beams have been suspended by special clips and adaptors from the roof trusses, and carry hoists.
Hand trucks	Two Lewis-Shepard lift trucks.
Hand hoists	Yale & Towne and Peerless at individual machines.
Fire extinguishers	Sand and water pails installed at convenient points.
Storage shelving	Light pressed steel type, painted dark green. Sectional construction. Some sections equipped with galvanized sheet metal boxes with wood ends, 6 x 6 x 12 in. in size, for small parts.
Storage racks	Easels of wood on steel framework, to carry tools such as drills, taps, reamers, cutters, etc.
Factory benches	Pressed steel legs. Heavy yellow pine tops. Heights, 32 to 36 in.
Safeguards	Machinery guards made of perforated metal on steel angle framework.
Wash bowls	Bradley Manufacturing Company multiple type wash fountains.
Closets	Frost-proof, automatic-flush type, porcelain.
Urinals	Porcelain.
Toilet partitions	Weisteel, set 12 in. up from floor.
Drinking fountains	Pedestal bubbler type with ice cooling attachment.
Plant communication	Bell telephone system with shop extensions.
Time system	Time recording clocks for in and out times and for times on jobs in one-tenth hours. Used also by night watchman to record rounds.
First aid equipment	First aid cabinets.

Testing Westinghouse Transformers

Equipment and Methods Used at the New Sharon Plant

By C. H. CHAMPLAIN

Works Manager, Westinghouse Electric and Manufacturing Company, Sharon, Pennsylvania

IN the Westinghouse transformer plant at Sharon, each and every piece of the completed product is subjected to rigorous inspection and test.[1] This work is done by well planned and adequately equipped testing departments located in the respective sections. The testing department is organized into three divisions. One division handles all types of instrument transformers and distribution transformers up to 50 kva., another department the high voltage distribution transformers and medium-size power transformers, and the third division all large power transformers.

The testing equipment in each division is segregated so that the different lines of product may be handled independently without allowing the tests to interfere, one with another. The principal object in mind is to have the product pass through the testing department in the same manner as straight line production is handled through the manufacturing sections. The equipment is so arranged that, while certain groups of testers are carrying on one kind of a test, other groups of testers may be carrying out other tests on similar lines of product. This work is done in numerous test booths which are supplied with power from the different sources as the occasions demand. Each and every test booth and source of power is interlocked electrically, which precludes connecting any two test booths or sources of power accidentally.

[1] See MANAGEMENT IN MANUFACTURING, October 1925, pp. 181-186, for article describing complete new transformer plant of Westinghouse Electric and Manufacturing Company.

FIG. 1 TESTING SMALL TRANSFORMER TANKS FOR LEAKS TO ASSURE PROPER WELDING

The small and medium-size test departments are located on the same floor as the assembly sections. In the large power testing department, however, large pits have been provided, both for convenient access-

FIG. 2 TESTING FINISHED SMALL TRANSFORMERS

sibility to the transformers, and for the additional head room necessitated in handling large units. These pits vary in depth from 12 to 14 ft. and are approximately 30 ft. in width and 80 ft. in length.

The testing equipment in the power transformer testing department for conducting efficiency and temperature tests consists of three 3300-kva., 26,000-volt, 60-cycle transformers; four 2500-kva., 26,000-volt, 25-cycle transformers; two 3-phase transformers rated at 500 and 750 kva. and 10,000 and 25,000 volts, respectively; also a number of other transformers ranging from 1500 kva. down to 100 kva. All of these transformers have multi-tap primaries and multi-coil secondaries, which affords a great range of both voltage and current values. The testing equipment in the nature of transformers is installed along the sides of the pits. The transformers are on the same level as the pit bottoms and the testing booths for the control of the transformers are located directly over the transformers on the working floor level. This arrangement economizes space, makes all parts accessible and affords convenience in connecting up apparatus.

The insulation testing equipment consists of an 800,000-volt transformer, a 500,000-volt transformer,

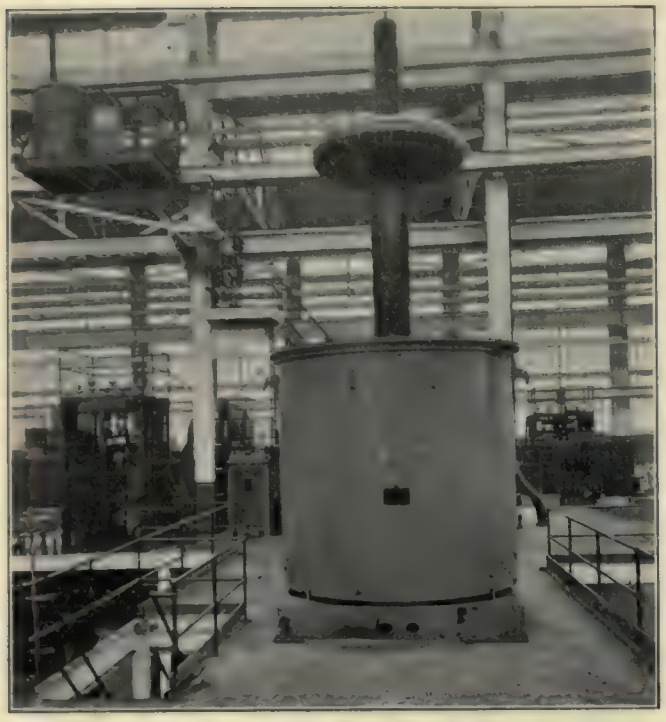

FIG. 3 CENTRAL PORTION OF TEST FLOOR SHOWING 500,000-VOLT TESTING TRANSFORMER, ALSO 150,000-VOLT TESTING TRANSFORMER MOUNTED ON PLATFORM-TYPE CRANE

and two 150,000-volt transformers. The 150,000-volt transformers and the respective control equipment are mounted on traveling cranes. This affords a ready means for locating the apparatus at any desired point throughout the length of the department. The 800,000- and 500,000-volt transformers are located centrally relative to the large testing pits.

As all power for the plant is supplied through a 12,000-kva. sub-station at 60 cycles, suitable frequency changers and motor-generator sets have been installed for supplying testing power. The sub-station transformers have three windings, namely, one primary and two secondaries, the latter for 2200 and 6600 volts.

The 2200-volt windings supply the shop and the small and medium-size test departments. Both 6600- and 2200-volt circuits lead directly to the power transformer test department. The 6600-volt circuit is used principally for supplying power to large motor-generator sets. In the small and medium-size test departments are located a 500-kva., 3-phase, 2300-volt, 25-cycle generator direct connected to a 60-cycle synchronous motor; a 300-kva., 3-phase, 2300-volt, 60-cycle generator direct connected to a 60-cycle synchronous motor; a 120-kva., 3-phase, 2300-volt, 400-cycle outfit; and a 300-kva., 3-phase, 25-60-cycle generator direct connected to a 250-volt variable speed motor.

The rotating apparatus for supplying power in the power transformer testing department consists of the following motor-generator sets: One 4-unit, 10,000-kva., 3-phase, 25-60-cycle outfit; one 3-unit, 5000-kva., 60-cycle outfit; one 5000-kva., 3-phase, 60-25-cycle outfit; two 4-unit, 1500-kva., 3-phase, 50-60-cycle outfits; and two 2000-kva. (5-min. rating) 175-cycle outfits.

In practically all cases the driving motors are of the synchronous type. The object of installing synchronous motors is to maintain approximately unity power factor on the incoming supply system. Transformer testing, as a rule, imposes conditions of very low power factor on the testing circuits, which, of course, would be very objectionable if reflected back into the power supply circuits. This condition is one of the reasons for locating the rotating apparatus in the testing department rather than at a remote sub-station.

The necessary exciters and control equipment for all of the apparatus are located in a basement extending underneath one section of the testing floor proper.

Since one section of the testing department consists of pits and another section is the basement, it was necessary to erect substantial foundations to bring the motor-generator sets to the shop floor level. This arrangement afforded a very simple method of installing circuit breaker cell compartments. Consequently, the circuit breakers for the respective sets are located in concrete cells directly underneath the outfits. Power is distributed from the different generators to various test booths through a centrally located distribution switchboard.

The testing department was laid out and equipped for testing the largest sizes of transformers that might be manufactured. For example, no difficulty would be experienced in testing those rated up to 50,000 kva.

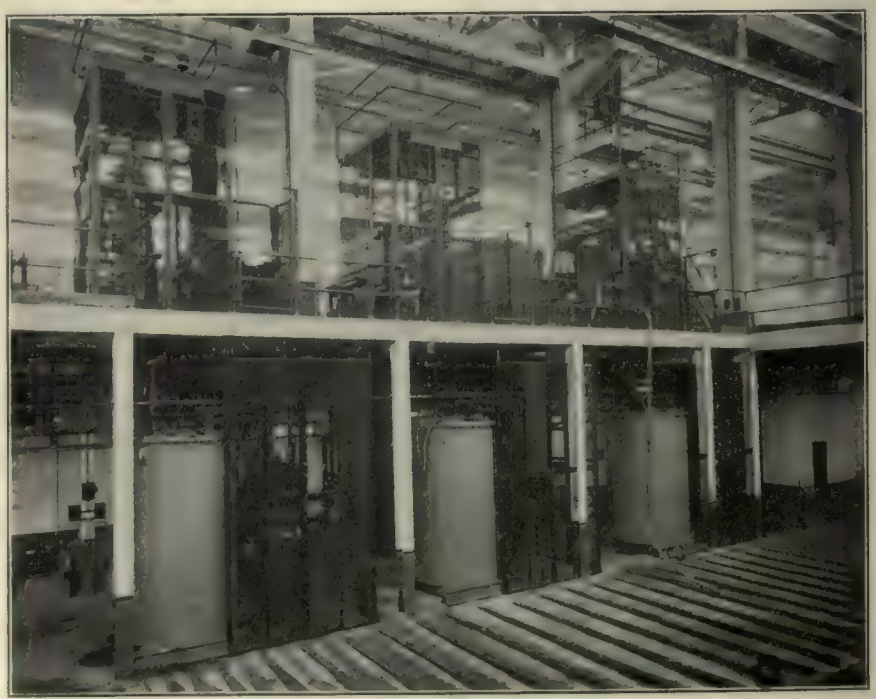

FIG. 4 SECTION OF TEST PIT SHOWING THREE 3300-KVA. LOADING TRANSFORMERS AND TEST BOOTHS

Quality and Quantity of Output Depend Upon Trained Employees

Management in Southern Furniture Plants

By CHARLES F. SCRIBNER

Management Engineer

A COMBINATION of circumstances has favored the South in the production of medium-grade furniture. The extent of this business is shown in Table 1.[1]

One of these favorable conditions is the mild winters, resulting in a minimum investment for buildings and a low cost for heating even in the coldest weather. A more important factor is the fine body of intelligent American labor which is available for employment. To some extent this latter factor has offset the failure on the part of many managers to adopt and install modern methods of management and manufacturing. Where such methods have been adopted to aid in securing an interested personnel, the results have been really surprising.

TABLE 1. CARLOADS OF FURNITURE SHIPPED

	For United States	*For 5 Southern States*
1921	53,210	8,986
1922	75,726	15,387
1923	98,462	23,095
1924	94,221	24,878

In creating an employment department the usual practice is to delegate to it the authority and responsibility for hiring all help required in the plant. This practice has been departed from in furniture manufacturing and the action of the employment supervisor is limited to interviewing and selecting suitable applicants, who are referred for final decision to the department foreman who sent in the labor requisition.

Discharge of an employee is handled entirely by the employment supervisor. When an employee is unsatisfactory or his usefulness ceases, the foreman provides him with a slip which carries him to the employment supervisor. The latter investigates the matter and tries to adjust any differences which may exist. If the foreman agrees, an effort is made to place the employee in some other department of the plant. Should he insist that the man be discharged, the employment supervisor closes the man's record by proper entries, secures his final pay and terminates his employment. This insures that employee records will be complete in event any one returns for re-employment.

The employment supervisor is also charged with responsibility for keeping in close touch with each new employee during the first six weeks of his employment. He sees that promises which have been made to the new man are kept; that they are given opportunities to earn higher wages through some of the wage incentive plans in use; and that they become steady, loyal and contented workers.

To secure these results the employment supervisor makes a weekly report to the factory manager, detailing conditions as to each employee who is likely to become dissatisfied. This directs the attention of the factory manager to specific cases and permits him to handle the situation direct with his foremen, thus saving to the organization many men who have later proved valuable employees, as well as reducing labor turnover.

Training the Employee

Systematic methods of apprenticeship are unknown in the southern furniture industry. Inexperienced workers are carefully taught one or several tasks, being gradually trained into relatively high-priced specialists, or else workers are hired away from competing concerns. Those who have a native ability above the average demonstrate it in their daily work, and are promoted to better paying positions as opportunity offers.

To keep spoiled work at a minimum, reduce breakage of tools and machinery, and avoid costly accidents, a definite training of employees has been found very profitable. For accomplishing this an experienced worker is assigned to train and instruct new employees in each of the important departments. As this instructor works directly under the department foreman his efforts are centered where they are most needed and any spare time which he has is applied to productive work.

This feature of training new employees has resulted in more quickly and uniformly attaining high production standards, has brought higher wages to the new man in a shorter time, and has materially reduced the chances of his leaving before he actually learns to do one thing well and is receiving pay sufficient to make him contented.

Any elaborate program of employee training has been found unwise and unprofitable. On the average

[1] Preceding articles appeared in MANAGEMENT AND ADMINISTRATION, June 1925, pp. 521-524; August 1925, pp. 83-86; September 1925, pp. 145-148; October 1925, pp. 217-220.

the plants are small and the best results have come from an intensive training of the employee on the job he is doing, at the same time encouraging him to learn other jobs in order to become a more valuable employee. The charts which are a part of this article tell the story as to the wisdom of these methods.

Results from Employment Department

Results that have come from the introduction of an employment department have been both tangible and intangible. The records of one year's operation in a group of plants operated by the same management and employing a normal combined working force of 425 workers, will be of interest. The employment function was started at the end of the first month of the year and the employment supervisor, a former foreman, had to be trained in the detail of his new duties.

Fig. 1 shows the length of service of employees leaving the company, compares the two semi-annual periods and gives data as to both white and colored labor. It will be seen that during the second half of the year there was a marked reduction in the number of "floaters" whose apparent desire was to get a few weeks' pay, quit and move on to some other plant. Accumulated employee record cards did much to put a stop to this condition, as men of this class were not sent to the foremen.

An analysis of the causes for employees leaving during the two semi-annual periods is shown in Fig. 2. Study of this chart will reveal a reduction in the number of employees leaving without giving notice, a less number because of unsatisfactory wage conditions, and a considerable reduction in number of terminations from being unsatisfactory or incompetent. These results can be credited to the careful scrutiny of the employment supervisor before sending applicants to foremen and to the close follow-up of new employees who had once gained a payroll status.

The comparative labor turnover in the several departments for the two periods and the departmental employment costs over a period of one year, are shown in Fig. 3. With the first six months charted it became a simple matter to give special attention to weak places, with the result that the following period showed a decided reduction in the labor turnover costs. However, it was only when intelligent effort was applied to the conditions shown by these charts that more profitable results were secured. The charts themselves simply pointed out where attention should be given.

Day Wage Plan Most Generally Used

It is only in a few instances that southern furniture plants have adopted some one of the more modern plans of wage incentive for the payment of employees in proportion to their efforts. Most plants hold to the straight hourly rate, with a limited number operating on the piece-work plan. In practically all plants where piece work exists, the rates are set by agreement between the foremen and the workers; such rates being very seldom set from detailed time study analysis of the work to be performed and correction of unfavorable conditions which may surround its performance.

As is to be supposed, the output of employees under these methods is but 60 to 70 per cent of what it should be; the employees are given to systematic soldiering even in plants where piece rates are paid; and labor cost becomes more or less of a fixed quantity—and fixed at a high, not a low level.

Practical and successful incentive wage plans have

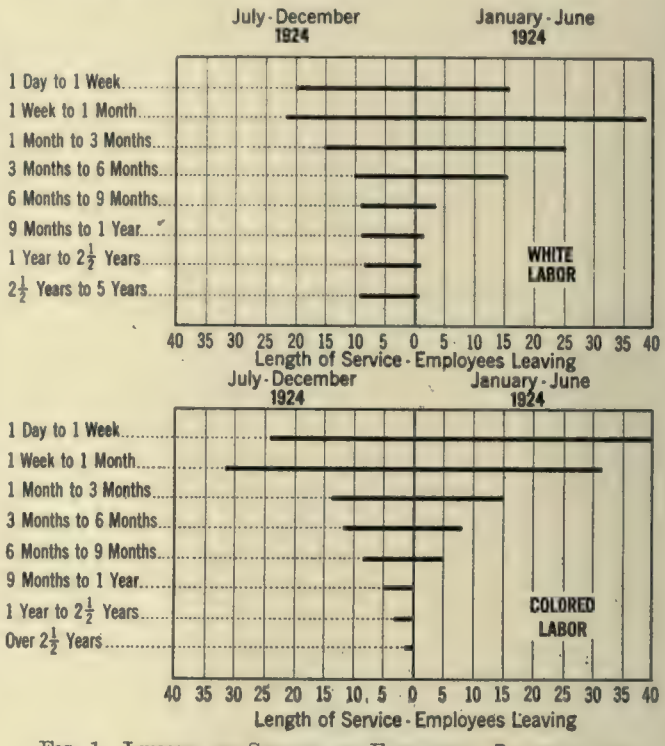
July-December 1924
January-June 1924
1 Day to 1 Week
1 Week to 1 Month
1 Month to 3 Months
3 Months to 6 Months
6 Months to 9 Months
9 Months to 1 Year
1 Year to 2½ Years
2½ Years to 5 Years
WHITE LABOR
40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40
Length of Service - Employees Leaving
July-December 1924
January-June 1924
1 Day to 1 Week
1 Week to 1 Month
1 Month to 3 Months
3 Months to 6 Months
6 Months to 9 Months
9 Months to 1 Year
1 Year to 2½ Years
Over 2½ Years
COLORED LABOR
40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40
Length of Service - Employees Leaving

FIG. 1 LENGTH OF SERVICE OF EMPLOYEES LEAVING THE COMPANY

been introduced into a number of progressive plants. Such plans have had for their basis a detailed analysis of conditions surrounding the work in each department and the development of a plan best adapted to meet the conditions which exist. Any attempt to apply the same plan throughout all departments of a plant will meet with only partial success, if not complete ultimate failure. Conditions in the various departments are so radically different that each department must be treated on its own basis.

Experience has shown that the major departments are best served by the plans which are specified in Table 2.

Time Study Operation Analysis

The basis upon which successful incentive wage payment plans must be constructed is detailed time study operation analysis of each of the operations for which rates are to be set or output standards established. The purposes of such studies are twofold:

1. To determine the unnecessary part of the operation as it is being performed, as a basis for correcting and standardizing conditions, permitting regular and consistent attainment of high production standards.

2. To serve as the basis for scheduling and for the determination of what constitutes a day's work and of what incentive is necessary for obtaining the desired output day in and day out in operation.

In this article no attempt is made to explain the detail and technique of taking time studies and analyzing them, as this has been covered in many excellent articles.[1] When a standard rate or a production standard has been arrived at it has been found essential for the time study observer to convince the foreman and get his approval of its fairness before it is put into effect. Neglect to do this will cause endless trouble in operating the standards.

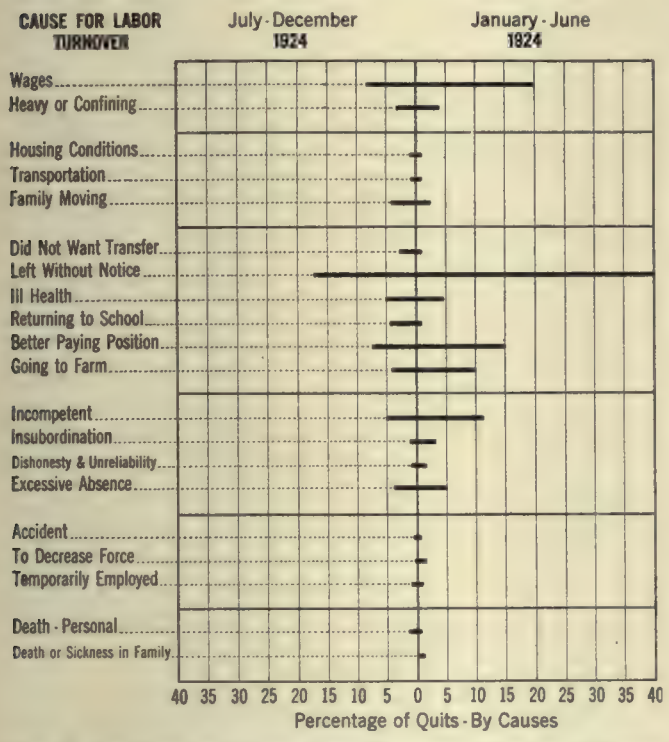

FIG. 2 ANALYSIS OF CAUSES FOR EMPLOYEES LEAVING DURING THE TWO SEMI-ANNUAL PERIODS

The efficiency attained in performance of any operation or group of operations is progressive. As a number of improvements will be made in operating conditions during the first few months, the first standards or piece rates should be "temporary standards," the same not being guaranteed against change for any length of time. Later, when conditions have been standardized, "permanent standards," guaranteed against change for a period of six months unless changes are made in the equipment or in methods of doing the work, are established.

Theoretically it is best not to establish piece rates or set task standards until conditions have been corrected and a relatively high degree of efficiency can be secured. In practice, however, it is found necessary for ultimate success to establish temporary rates and standards to provide increased earnings for the workers during the transition from the older day wage plan to the newer incentive methods. There has been no difficulty experienced in revising these temporary rates and standards, when employees have had the plans carefully explained to them at the start and when pains are taken to see that each week they make wages in excess of what they previously earned.

[1] See files of MANAGEMENT IN MANUFACTURING and Management's Handbook.

TABLE 2. INCENTIVE WAGE PLANS IN VARIOUS DEPARTMENTS

Department	*Wage Plans*
Machine	Individual Piece Work. Rates set from time study operation analysis.
Cabinet	Group Piece Work for sub-assemblies. Task and bonus for final assembly.
Finishing	Group Piece Work for minor operations. Individual piece work for spraying work.
Shipping	Group Piece Work for car loading. Task and bonus for crate making, crating, etc.
Yard	Group Piece Work for unloading lumber, loading and unloading dry kilns, etc.

Preparing Production Standards for Use

As they have been applied in a number of plants, production standards for the three principal producing departments are shown in Table 3. The standard time and standard output for each operation is entered on part analysis cards, which are filed in each department. The sum of the times for all operations performed on any unit in one department makes the figures referred to above.

These figures are based upon the departments operating at 90 per cent efficiency, thus they are directly

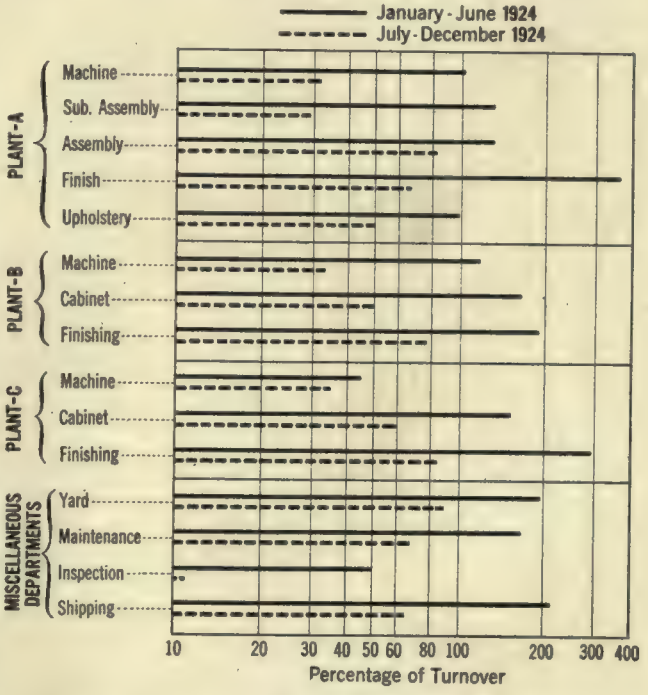

FIG. 3 COMPARATIVE LABOR TURNOVER IN SEVERAL DEPARTMENTS

usable for purposes of scheduling. In practice it is found that actual efficiency will range up to 94 to 97 per cent, but it is not safe to schedule at maximum efficiency, as foremen and employees become quickly discouraged if they do not perform according to schedule.

The incentive which is necessary to secure attainment of the standard task varies with the conditions in each individual plant, the character of the workers employed, the conditions under which they live, and the opportunity afforded them to improve their individual status. To show how this incentive varies for the different classes of work in the several departments, Table 4 is prepared from the experience of a number of installations of wage incentive plans in this industry. This shows the amount of incentive which has been found necessary to secure the desired results under conditions prevailing in this industry in a specific locality.

TABLE 3. PRODUCTION STANDARDS, MACHINE, CABINET AND FINISHING DEPARTMENTS (MARTIN FURNITURE COMPANY)

	Hours per Unit		
	Machine Department	Cabinet Department	Finishing Department
#240 Table	1.73	1.15	2.60
#240 Buffet—60"	2.55	3.18	3.02
#241 Buffet—66"	2.81	3.54	3.78
#240 China Closet	2.69	2.66	3.92
#241 China Closet	2.77	2.76	4.10
#240 Serving Table	1.28	2.19	1.74
#240 Arm Chair	0.77	0.02	1.02
#240 Side Chair	0.52	0.02	0.93

Incentive plans which do not include extra compensation for foremen, based upon the results secured in their departments, do not accomplish all that they should. When the interest of the foremen is directed in the same channel as that of the workers—high production, minimum delays, and lower total cost—his interest in his job is greatly increased, there is a reduction in labor turnover and overtime hours, and more profitable operation follows naturally.

TABLE 4. STANDARD PRACTICE INSTRUCTIONS, BASE RATES, INCENTIVES, AND EARNED RATES FOR MAJOR DEPARTMENTS

Classification	Base Rate Per Hour	Incentive Per Cent	Earnings Per Hour
Machine Dept.			
Moulder, Shaper, Band Saw, Variety Saw	$ .38	30	$ .48
Cut-off Saw, Rip Saw, Hand Sander, Planer, Tenoner	.34	30	.44
Mortiser, Dovetailer, Trim Saw, Mach. Sander	.30	25	.37½
Boring, Turning, Helpers and Learners	.27½	20	.33
Cabinet Dept.			
Fitters, Assemblers	.36	30	.46½
Frame and Drawer Assemblers	.32	25	.40
Hand Sanders	.28	25	.35
Helpers and Learners	.25	20	.31
Finishing Dept.			
Spray Operators	.36	30	.46½
Brush and Stain Operators	.32	25	.40
Hand Sanders	.28	25	.35
Helpers and Learners	.25	20	.31
Packing and Shipping Dept.			
Rubbers, Uphtters	.33	25	.41
Packers and Craters	.30	25	.37½
Crate Makers	.27½	22	.33
Helpers and Truckers	.25	20	.31

One of the chief objections of the plant manager against the introduction of incentive wage plans is that such plans stimulate quantity at a sacrifice of quality. Actual experience proves that where workers are trained to think of quality first, a larger output is automatically secured. The skilled worker is always a fast worker and he takes just as much pride in his record for quality as he does for the quantity he produces.

Control of quality in furniture manufacture is insured through inspection that holds the product to definite and uniform high standards at all stages in its manufacture. Some managers have objected to the introduction of an inspection department, claiming that the extra cost is not warranted, as the foremen handle this work as a part of their regular duties. Such claims are only made because of an entire absence of facts. When a foreman gives his time to the details of inspection, other duties suffer from neglect; when it is shown that from 25 to 40 per cent increase in output is possible through wage incentive plans, the cost of the inspection that is required sinks into insignificance as compared with the benefits secured.

(To be concluded in December issue.)

Passenger Trailer Car

A PASSENGER trailer for a trackless train, now in use by the packing houses connected with the Chicago stock yards, is shown in the accompanying photograph. It forms a convenient means of taking visitors and executives on inspection tours through plants where industrial tractor and trailer systems are in service.

The car is of steel, mounted on an all-steel trailer chassis. It carries four comfortable leather-seat chairs. The four wheels are of ball-bearing castor type, rubber-tired, and the rear wheels run on Hyatt roller bearings. The car has a small draw bar pull and is easy to turn within small spaces and around corners. It is used singly or in trains, either directly back of the tractor, or attached to the rear of one or more freight trailers. It is made by the Mercury Manufacturing Company.

FIG. 1 FOUR-PASSENGER TRAILER FOR TRACKLESS TRAIN

Selecting the Proper Container

Experience Data Demonstrating Actual Savings Brought About in Shipping Costs

THE manufacturer endeavoring to attack and reduce his distribution costs must weigh many factors when he investigates the problem of cutting his shipping expenses. The job is not just one of making or buying any sort of containers that are cheap in first cost. Twelve of the points to be considered have already been discussed,[1] but there are at least 12 others to be taken into account. These are presented in the following paragraphs.

Protection against Theft. The regular wood box can be opened, rifled and closed again without external evidence of robbery. Even the usual strapped box can be tampered with successfully. The wirebound box, however, can be opened only by cutting or untwisting the wires, but when an attempt is made to retwist them, they break off. If a sealing strip is used, the fiber case cannot be opened without breaking its seal. Hence, with these types of containers the consignee can see that the box has been opened and refuse the shipment.

Freight Rates. A reduction of freight rates is an almost invariable rule by the substitution of fiberboard or wirebound containers for the usual wood boxes and crates, on account of the reduced weight. The best proof is obtainable from typical instances, many of which are listed in Tables 1, 2, 3 and 4.

Possibility of Container Standardization. A study of packing methods, where such has not already been made under expert advice, will usually show that some shapes and sizes of containers in use can be eliminated. Standardization on a few sizes lowers costs because of increased quantities of one kind purchased, and lowers inventory charges because only a small total stock need be carried. Moreover, if a box or crate which is standard with many of the container manufacturer's customers, can be used, the initial cost and required stock in any customer's storage will be still further reduced because the article is a regular product on the market.[2]

Storage Space. All fiberboard and wirebound containers are shipped and stored knocked down. Hence the transportation and storeroom charges are low. Where boxes are manufactured by the user, lumber transportation includes charges on waste materials. If regular wood boxes are bought outside, they often come assembled except for the nailing on of the lids. In such instances both the transportation and storage spaces required are several times larger than with knocked-down types, with a much higher resultant cost. Plant handling charges on both unfilled and filled fiberboard and wirebound cases are also greatly reduced, due to less weight and greater convenience of moving containers.

[1] See MANAGEMENT IN MANUFACTURING, October 1925, pp. 199-200, for the first portion of this discussion.

TABLE 1. SAVINGS BY ELIMINATION OF WOOD CASES

Average results of a study made by a Paperboard Industries Association representative at receiving rooms in 25 large department stores throughout the United States, showing savings possible by substitution of fiber containers.

ITEM	CASE 1	CASE 2	CASE 3	CASE 4	CASE 5	CASE 6
Product	Men's shirts	Corsets	Underwear	Hosiery	Pillows	Bedspreads
Freight saving per wood case by substituting corrugated strawboard	$1.75	$0.97	$1.64	$1.19	$2.05	$0.89
Freight saving per wood case by substituting solid fiberboard	$1.31	$0.835	$1.22	$0.91	$1.02	$0.69
Average number of dozens per case	23	6	29.8	70.1	8.3	3.4
Average freight rates of all forms, per cwt.	$2.52	$2.52	$2.52	$2.52	$2.52	$2.52
Average possible savings per doz. at average freight rates, by use of corrugated containers	$0.076	$0.162	$0.055	$0.017	$0.247	$0.261
Average possible savings per doz. at average freight rates, by use of solid fiberboard containers	$0.057	$0.139	$0.04	$0.013	$0.123	$0.204

TABLE 2. TYPICAL SAVINGS BY FIBERBOARD CONTAINERS[1]

ITEM	CASE 1	CASE 2	CASE 3	CASE 4	CASE 5
Product	Light articles	Underwear	Men's shirts and drawers	Sliced pineapple	Glass water jugs
Quantity in former container, dos.	.....	.....	24	2	3 (2 dos. in new type)
Former type of container	Wood box	Wood case	Wood case	Wood box	Wood barrel
Weight, lb.	22	94	129 filled	63 filled	36
New type of container	Corrugated strawboard	5 corrugated strawboard boxes	4 solid fiber boxes	Corrugated fiber boxes	Corrugated fiber boxes
Weight, lb.	3½	22½	40 filled	57 filled	9
Difference in weight, lb.	18½	71½	89 filled	6 filled	27
Freight rate per cwt.	$2.00 (assumed)	$3.75 (from east to Denver)	$1.35	$1.05	$0.39½
Savings in transport cost per each new type of container	$0.37	$0.54	$0.30	$0.069	See footnote 2
Cost of old type container	.....	.....	$4.29	.....	$0.78 excluding paper and straw
Cost of new type container	.....	.....	$1.42	.....	$0.35 including partitions
Total Savings per unit lot	.....	.....	.07	.....	See footnote 2

[1] Data from the Paperboard Industries Association.
[2] Carloads averaged 750 dos. jugs when in barrels, but 1400 dos. jugs when in fiber boxes, giving a total saving of $41.47 on 1400 dos. or $0.03 on each doz. In addition, breakage was reduced one-half.

[2] The Division of Simplified Practice, Department of Commerce, has cooperated with many trade associations and manufacturers along the lines of eliminating sizes of shipping containers, as well as sizes and styles of products.

TABLE 3. TYPICAL FREIGHT SAVINGS BY USE OF FIBER BOXES[1]

Fiber boxes, which are the lightest weight shipping container, assure appreciable savings in freight and express charges. The saving per box, when multiplied by the number of boxes in the shipment, or in the car, and further by the number of shipments per year, frequently mounts to thousands of dollars. A careful compilation shows that the AVERAGE saving in freight costs by reason of using fiber boxes to displace heavier weight containers is approximately 12 per cent.

The following table was compiled in September 1925 from actual cases, based upon current rates of freight and express, and shows savings brought about by reason of lesser weight of fiber boxes in comparison with containers of heavier weight, for identical shipments.

BY FREIGHT

Product	Freight Classification	Shipped From	Shipped To	Freight Rate per 100 lb.	Weight Saved by Use of Fiber Boxes to Displace 1 Wooden Box, lb.	Cash Saving in Freight
Blankets	First Class	Chicago, Ill.	Denver, Col.	1.765	31	$0.55
Blankets	"	New York City, N. Y.	St. Paul, Minn.	1.95	46	0.90
Candles (fancy)	"	New York City, N. Y.	Birmingham, Ala.	1.28	14	0.18
Corsets	"	New York City, N. Y.	San Francisco, Cal.	4.80	33	1.58
Corsets	"	Chicago, Ill.	Spokane, Wash.	4.80	33	1.58
Gloves	"	New York City, N. Y.	Providence, R. I.	0.665	63	0.42
Hosiery	"	New York City, N. Y.	St. Paul, Minn.	1.89	28	0.53
Hosiery	"	New York City, N. Y.	Seattle, Wash.	3.75	27	1.01
Hosiery	"	Bay City, Mich.	Cleveland, Ohio	0.82	59	0.48
Hosiery	"	New York City, N. Y.	San Francisco, Cal.	4.80	39	1.88
Pajamas	"	New York City, N. Y.	Providence, R. I.	0.665	30	0.20
Paper, Writing	"	New York City, N. Y.	Los Angeles, Cal. (via boat)	1.50	98	1.47
Shirts, Men's	"	New York City, N. Y.	Portland, Ore.	3.75	62	2.32
Shirts, Men's	"	Philadelphia, Pa.	Los Angeles, Cal.	3.75	35	1.32
Shirts, Men's	"	New York City, N. Y.	Chicago, Ill.	1.42	62	0.88
Shirts, Men's	"	New York City, N. Y.	Birmingham, Ala.	1.875	44	0.83
Underwear	"	New York City, N. Y.	Washington, D. C.	0.70	75	0.53
Underwear	"	New York City, N. Y.	Portland, Ore.	3.75	46	1.72
Underwear	"	New York City, N. Y.	Los Angeles, Cal.	3.75	49	1.84
Underwear	"	Utica, N. Y.	Chicago, Ill.	1.135	41	0.47
Underwear	"	Kenosha, Wis.	St. Louis, Mo.	0.87	20	0.17
Underwear	"	Kenosha, Wis.	Denver, Colo.	2.735	20	0.55
Underwear	"	Kenosha, Wis.	Los Angeles, Cal.	3.21	20	0.64
Underwear	"	Kenosha, Wis.	New Orleans, La.	2.07	20	0.41
Yarn	"	Utica, N. Y.	Kenosha, Wis.	1.17	44	0.51

BY EXPRESS

Product	Express Classification	Shipped From	Shipped To	Express Rate per 100 lb.	Weight Saved by Use of Fiber Boxes to Displace 1 Wooden Box, lb.	Cash Saving in Express
Hosiery	First Class	New Orleans, La.	Cleveland, O.	5.05	29	$1.46
Hosiery	"	Winstead, Conn.	Philadelphia, Pa.	2.96	17	0.50
Pillows	"	New York City, N. Y.	San Francisco, Cal.	11.10	53	5.90
Shirts, Men's	"	Racine, Wis.	Cleveland, O.	2.28	30	0.68
Underwear	"	New York City, N. Y.	Philadelphia, Pa.	1.45	20	0.29

[1] Data compiled by the Paperboard Industries Association.

TABLE 4. SHIPPING SAVINGS BY WIREBOUND BOXES[1]

The table below was compiled February 1, 1925, from actual cases and shows in a concrete way what extra pounds cost in transportation. The savings when multiplied by the number of boxes per car, and again by the number of cars per year, frequently run into thousands of dollars. In many instances the amount saved per box exceeds the cost of the wirebound container.

BY FREIGHT

Product	Freight Classification	Shipped From	Shipped To	Freight per 100 Lb.	Weight Saved by Wirebound Box Now Used, Lb.	Cash Saving Per Box
Curtains, Side for Automobile	First (CL)	Fremont, Ohio	Los Angeles, Cal.	$5.25	30	$1.575
Shirts, Work	Commodity (LCL)	Chicago, Ill.	Los Angeles, Cal.	3.21	43	1.38
Curtains, Side for Automobile	First (LCL)	Fremont, Ohio	Denver, Colo.	3.425	30	1.03
Tape, Gum and Paper Rolls, Adding Machine	Commodity (LCL)	Neenah, Wis.	New Orleans, La.	1.21	40	0.484
Belts, Rubber Fan	First (LCL)	Philadelphia, Pa.	Chicago, Ill.	1.35	35	0.47
Bottles, Thermos	First (LCL)	Norwich, Conn.	Chicago, Ill.	1.20	30	0.36
Shirts, Work	First (LCL)	Chicago, Ill.	Cincinnati, Ohio	0.805	43	0.346
Drugs	First (LCL)	St. Louis, Mo.	Denver, Colo.	2.46	8	0.197
Furnace Parts	Fifth (CL)	Dover, N. J.	Omaha, Neb.	0.98	20	0.196
Soap	Fifth (CL)[2]	Milwaukee, Wis.	San Francisco, Cal.	1.00	17	0.17
Meats, Fresh	Second (LCL)	Chicago, Ill.	Dawson, Ga.	2.405	5.2	0.125
Furnaces	Fifth (CL)	Dover, N. J.	Chicago, Ill.	0.565	20	0.113
Hardware	Second (LCL)	Chicago, Ill.	Arkansas City, Kan.	1.76	6	0.105
Soap	Fifth (CL)[2]	Milwaukee, Wis.	New York City	0.565	17	0.096
Ink, Printing	Second (LCL)	Philadelphia, Pa.	Natchez, Miss.	1.88	5	0.094
Batteries	First (LCL)	Chicago, Ill.	Topeka, Kan.	1.515	4.5	0.068

BY EXPRESS

Product	Classification	Shipped From	Shipped To	Express Per Lb.	Weight Saved By Wirebound Box or Crate, Lb.	Cash Saving Per Box or Crate
Shirts, Work	First	Chicago, Ill.	Fort Worth, Tex.	$0.0554	43	$2.37
Ferns, Fresh	First	Jupiter, Fla.	Chicago, Ill.	0.062	7	0.434
Meat, Smoked	Second	Chicago, Ill.	Louisville, Ky.	0.0146	14.7	0.215

BY PARCEL POST

Saving on parcel post shipments will compare closely with those for express on all packages within the 70-pound weight limit for first, second, and third zones, and 50 pounds for all others.

[1] From "Guardians of Good Merchandise," Wirebound Box Manufacturers Association.
[2] Special Commodity for Export.

Ford Plant Enlarges Power Capacity

Features of New Equipment and Operating Data on Power House

By GEORGE E. HAGEMANN

Associate Editor, MANAGEMENT IN MANUFACTURING

THE new impulse-type turbo-generators, of 62,500 hp. each, comprising the latest units planned for the River Rouge power plant of the Ford Motor Company, are of Ford design and manufacture.[1] Three are installed, three are being manufactured and erected and the remaining two will be built later. They generate electricity at 13,200 volts, and this is stepped down to 440 and 240 volts for use in the motors of the manufacturing buildings.

Fig. 7 shows one of these machines in process of assembly, with rotor and armature visible, and next to it a finished unit. The turbine is 29 ft. long, overall, and the generator 21 ft. 7½ in. long, overall. A view of one of the assembled machines is shown in Fig. 9.

The generators depart radically in many respects from present prime mover practice. They are the first to use all mica insulation, are ventilated on different principles, and are one-third less in size than other machines of the same capacity. Alternating current is generated.

In order to facilitate inspection of the rotor, a turning device is installed on each turbine, making it unnecessary to lift the rotor from its bearings. When the top casing has been removed, the rotor can be revolved by throwing in a switch controlling a 3-hp. crane motor, and operating through a differential planetary gearing and worm drive. An eccentric cradle carries this motor and its gearing, and they are swung into place or disengaged by means of a hand-operated worm and bevel gear.

Exciter units of 500 kw. capacity each, for the generator fields, designed and built by the Ford company, are mounted in a gallery above the turbine room floor. One exciter serves every two turbo-generators. Eventually five will be installed, one serving as an emergency outfit.

Each turbine is equipped with its own surface condenser. For the new units these condensers are of Ford design and manufacture. The shells are 14 ft. in diameter, 22 ft. long, and contain 34 miles of 1-in. brass pipe each. The exhaust opening is 11 ft. in diameter, and the hot well 4 ft. in diameter. Two air ejectors serve each condenser. Two 50-hp. Wheeler condensate pumps, each of 500,000 lb. water capacity

[1] See MANAGEMENT IN MANUFACTURING, October 1925, pp. 205-208, for the previous instalment of this article.

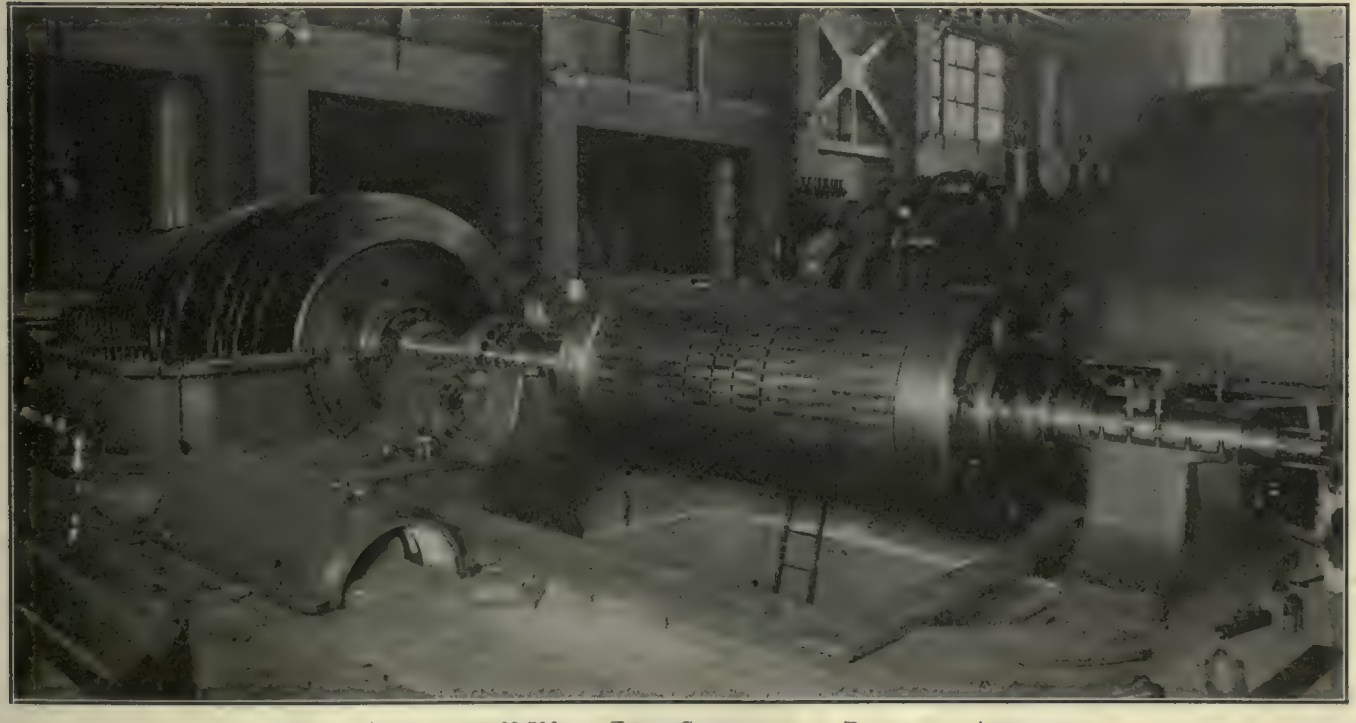

FIG. 7 ONE OF THE 62,500-HP. TURBO-GENERATORS IN PROCESS OF ASSEMBLY

FORD MOTOR COMPANY—ROUGE PLANT

POWER HOUSE NO. 1—CONDENSER ROOM

DATE—Jan. 13, 1925 WATCH NO. 1 TURBO-GEN. NO. 5 WEATHER—Clear

Time	11	12	1	2	3	4	5	6	REMARKS
Line Steam Press	230	237	240	238	238	237	237	238	
Radojet Steam Press. No. 1									Note here starting or securing of units with time and reason.
Radojet Steam Press. No. 2	150	150	150	150	150	150	150	150	
Vacuum Inches	28.6	28.6	28.6	28.6	28.6	28.6	28.6	28.6	
H. P. Oil Press	52	52	52	52	52	52	52	52	
L. P. Oil Press	27	27	27	27	27	27	27	27	Electric and steam circulating pumps run 8 hours.
Cooler Oil Sup. Temp	124	124	124	124	124	124	124	124	
Cooler Oil Dis. Temp	104	104	104	104	104	104	104	104	
Circ. Water Sup. Temp	52	52	52	53	53	52	52	52	
Circ. Water Dis. Temp	66	[illegible]	[illegible]	62	61	60	59	60	
Condensate Temp	86	84	78	78	78	76	76		
Seal Water Press	46	46	46	47	48	48	48	47	
Air Wash Nos. Press									
Barometer	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.3	
Steam Circulator	3800	3800	3800	3800	3800	3800	3800	3800	
Speed R.P.M.									
First Stage Press									
Oil Press	31	31	31	31	31	31	31	31	
Vacuum Inches									
Cooler Oil Dis. Temp	94	94	94	94	94	94	94	94	
Electric Circulator									
Speed R.P.M.									
Oil Press	4	16	16	16	15	15	15	15	
Cooler Oil Dis. Temp.									

Flow Meter readings at end of watch
No. 1 4521
No. 2 6766
No. 5 Steam Aux. 2550

Miller-Holland
Condenser Engr.

FIG. 8 LOG ON CONDENSER OF FORD NO. FIVE, 30,000-KVA. TURBO-GENERATOR, ONE SHIFT

Russell de-superheater to reduce it to saturation temperature in which condition it is more efficient as an evaporative medium, is supplied to distill this water over into receiving tanks. Impurities remain in the evaporator. The distilled water is then pumped into the boiler feed line as make-up water, at the rate of about 200 gal. per min.

A Manistee oiling system for each turbo-generator unit is located on the condenser floor. One pump, with a capacity of 400 gal. per min., takes care of two units. Two of these pumps are motor-driven and two are turbine-driven, placed alternately. If one pump should break down, the next will automatically take over its work. Each unit has separate oil filters, oil tanks and oil coolers.

A Carrier air washer for cooling and purifying the air supplied to ventilate each generator is mounted on a gallery between the condenser and turbine floors.

Table 2 gives averages from a 24-hr. operating log. In Table 3 are listed the main readings that are taken in the power house, with average values.

A log such as is taken in the condenser room, a summary of one day's power house output, and the form of monthly summary made are given, respectively, in Figs. 8, 10 and 11.

per hr., and two 600-hp. centrifugal circulating water pumps, of Ford design and make, are also supplied for each unit. From 30,000 to 60,000 gal. of cold water per min. are required for each condenser. One of each of the above pumps is motor-driven, and the other is steam turbine-driven.

The total weight of each condenser is 200 tons. On account of the expansion due to the heat, this weight is carried on 40 heavy springs.

At present the cooling water used comes from the River Rouge turning basin. When the power house is fully completed, however, the supply from this source will be inadequate, and a 25 ft. diameter tunnel leading direct from the Detroit River will be constructed and put into service.

FIG. 9 A COMPLETED 62,500-HP. UNIT

The condensate is pumped into tanks from which it is removed by centrifugal pumps into Hoppes open feed water heaters supplied with steam from the exhaust of the turbine-driven auxiliaries. These heaters are located in the evaporator room. From this point centrifugal feed pumps deliver it to the Hoppes closed heater through which live steam from the boilers is circulated. Then it is introduced into the boilers under 325 lb. pressure.

In this same room are Reilly submerged type evaporators. Mill water from the turning basin in the Rouge River is pumped through Massilon open heaters, supplied with exhaust steam, and then into the evaporators. Live steam, passed first through a Griscom-

TABLE 2. AVERAGES FROM 24 HR. OPERATING LOG

	Avg. Reading
Pounds of steam per pound of coal	10.37
Pounds of water from and at 212 deg. fahr. evaporated per lb. of coal	11.09
B. t. u. per lb of coal	14,200
Moisture in coal, per cent	3.6
Ash in coal, per cent	6.3
Average boiler horsepower generated, per hr. (5 boilers)	28,743
Average efficiency, per cent	83

FORD MOTOR COMPANY—ROUGE PLANT POWER HOUSE OUTPUT

ELECTRICAL ENERGY-OUTPUT IN KW.

Turbo-Generators	590,000
No. 3 Powerhouse	.....
No. 10 Powerhouse	11,980
House Set	8,620
Total Kw. Output	610,600

STEAM OUTPUT IN LBS.

Power House No. 1	.....
Power House No. 3	.....
Total Steam Produced	.....

P. H. No. 1 STEAM CONSUMPTION IN POUNDS

Turbo-Generators	.....
Turbo-Blowers	.....
Auxiliaries	380,000
By-Products	1,370,000
Foundry	925,000
Blast Furnaces	.....
Evaporators	1,100,000
House Sets	293,080
Heating	1,920,000
High Line	815,000
Total Steam Cons	.....

ELECTRICAL ENERGY CONSUMPTION IN KW. HR.

DURING ..... ENDING .....

Coke Ovens	.....
Blast Furnaces & Pig Cast	.....
Electric Furnaces	.....
Foundry Melting	.....
Foundry Machining	.....
Jobbing Foundry	.....
Motor Assembly	.....
Tractor—B. Bldg.	.....
Body Plant	.....
Construction	.....
Glass Plant	.....
Cement Plant	.....
Paper Mill	.....
Highland Park Plant	242,000
Lincoln Plant	30,000
D. T. & I. Shops	.....
Miscellaneous	.....
Total Kw. Hr. Cons.	.....

COAL COMBUSTION

Total Tar in gallons	11,934	B. T. U. in Coal	13,700
Total Coal in Pounds	569,966	Efficiency	83+%
Total Gas Equivalent in Pounds Coal	729,360	Moisture	3%
" " " " Tar " " " "	77,020	Ash	7.2%
Total Evaporation, Pounds Steam per One Pound Coal	10.83		
Total Evap. at 212°F., " " " " " "	11.58		
Average CO_2 in %	.....		

LOG OF OPERATION

BOILER NO.	1	2	3	4	5	6	7	8
Steam Pressure	241	238	.....	241	.....	242	242	.....
Steam Temperature	545	No Record	.....	580	.....	629	636	Avg. 598
Steam Flow in 1,000 Pounds	3,440	1,830	.....	3,640	.....	3,140	2,860	.....
Furnace Temperature	2,216	2,102	.....	2,283	.....	2,235	2,248	.....
Uptake Temperature	541	578	.....	520	.....	561	542	.....
Furnace Draft	0.24	0.30	.....	0.15	.....	0.28	0.40	.....
Uptake Draft	1.41	0.86	.....	1.64	.....	1.45	1.21	.....

Total Steam in Pounds 14,910,000
Total Hp. 488,552 Average Hp. in 24 Hr. 20,368

Make Up to Hot Well, Total Gallons	No Record	G. P. M.	.....	
Make Up to Evaporators, Total Gallons	232,100	G. P. M.	161.1	
Boiler Feed Water to Boilers, Total Gallons	.....	G. P. M.	.....	Temp. F. 250

STEAM CONSUMPTION IN POUNDS

DURING ..... ENDING .....

Coke Ovens	.....
Blast Furnaces & Pig Cast	.....
Electric Furnaces	.....
Foundry Melting	.....
Foundry Machining	.....
Jobbing Foundry	.....
Motor Assembly	.....
Tractor—B. Bldg.	.....
Body Plant & Dry Kiln	.....
Construction	.....
Glass Plant	.....
Cement Plant	.....
Paper Mill	.....
D. T. & I. Shops	.....
Miscellaneous	.....
Total Steam Consumed	.....

TURBO BLOWER NO.	1	2	3	4	5
Hours in Service	24	.....	24	.....	.....
R. P. M.	2,394	.....	2,692	.....	.....
Volume Cu. Ft. in 24 Hrs.	38,000	.....	36,000	.....	.....

PULVERIZER NO.	1	2	3	4	5	6
Hours in Service	.....	.....	.....	.....	.....	.....
Tons of Coal Received	635	.....	.....	.....	.....	.....
Tons of Coal Pulverized	565	.....	.....	.....	.....	.....
Tons of Sea Coal	None	.....	.....	.....	.....	.....

FIG. 10 TYPICAL DAILY POWER HOUSE LOG

The charts and logs taken on each shift are delivered to the office of the power house superintendent where they are carefully inspected. Then the data is compiled and entered on the daily summary sheet. At the end of the month the information on these summary sheets is tabulated on the monthly record.

TABLE 3. SUMMARY OF MAIN READINGS TAKEN IN POWER HOUSE

	Avg. reading
Output:	
Steam rate of turbines, lb. per kw. hr.	
Two 12,500 kw. machines	13
Two 30,000 Kva. machines	13½
Steam to auxiliaries, lb. per hr	65,000
Steam to foundry, for processing, lb. per hr	39,000
Steam to cement plant, lb. per hr	10,000
Steam for miscellaneous uses	
(See monthly log sheet, Fig. 11)	.....
Total steam generated, lb. per hr., approx	800,000
Water Supply:	
Furnace—mill water temperature, deg. fahr	60
Rouge water pressure, lb. per sq. in	60
Main header water flow, lb. per hr	750,000
By-Products mill water pressure, lb. per sq. in	35
Blast Furnace:	
Blower pressure, lb. per sq. in	13
Air flow to blast furnace, cu. ft. per min	42,000
Blast furnace gas pressure, in. of water	12
Blast furnace gas temperature, deg. fahr	280
Feed Water:	
Hotwell temperature, deg. fahr	130
Hoppes open feed water heater, temperature, deg. fahr., in	175
out	240
Griscom-Russell closed feed water heater temperature, deg. fahr., in	240
out	250
Vapor in closed feed water heater, pressure lb. per sq. in	25
Massilon open heater for make-up water, temperature, deg. fahr. out	150
De-superheater steam temperature, deg. fahr. in	610
out	430
Evaporator, water temperature, first stage, deg. fahr. in	175
out	240
Evaporator, water temperature, second stage, deg. fahr. in	240
out	250
Feed water from evaporators (250 deg. fahr.) gal. per min	220
Water to boilers, pressure, lb. per sq. in	325
Water to boilers, supplied by 2 centrifugal pumps, lb. per hr. approx.	850,000
Boilers:	
Steam pressure, lb. per sq. in	250
Steam temperature, deg. fahr	635
Flue gas temperature, deg. fahr	540
Air Pressure, in. water	7
Stack draft, in	1.30
Furnace draft, in	0 26
CO_2 recorder, per cent	16
Turbines:	
Vacuum, in. of mercury	28 to 28½
Condensers:	
Condensate temperature, deg. fahr	95
Miscellaneous:	
Compressed air for shops, pressure, lb. per sq. in	95
Foundry hot water heating, temperature, deg. fahr. dischg.	180
return.	168

FORD MOTOR COMPANY—ROUGE PLANT POWER HOUSE OUTPUT

ELECTRICAL ENERGY-OUTPUT IN KW.

No. 1 Powerhouse	
Turbo-Generator No. 1	5,326,000
" " 2	6,619,000
" " 5	6,394,000
" " 6	.....
" " 7	230,750
House Sets	.....
No. 3 Powerhouse	941,430
No. 6 Powerhouse	Not operating
No. 10 Powerhouse	199,360
Total Kw. Output	19,710,540

Remarks:

ELECTRICAL ENERGY CONSUMPTION IN KW. HR.

Auxiliaries	1,453,460	Slag Mill	38,000
Compressed Air	525,000	Paper Mill	67,000
Coke Ovens	736,640	Highland Park Plant	6,148,000
Blast Furnaces & Pig Cast	328,900	Lincoln Plant	771,500
Electric Furnaces	343,000	Dearborn Plant	242,050
Heat Treating	126,000	Dearborn Aviation	7,454
Foundry Melting	1,837,470	Flat Fock	132,950
Foundry Machining	1,288,500	Briar Hill	20,140
Jobbing Foundry	202,200	D. T. & I. Shops	115,360
Motor Assembly—Tractor	.....	D. T. & I. Railroad	.....
Motor Assembly—Model T	1,259,500	D. & I. Railroad	.....
Tractor—B. Bldg.	585,000	Michigan Central R. R.	468
Body Plant	935,000	Wabash R. R.	468
Construction	94,780	Pennsylvania R. R.	468
Pattern	17,200	Miscellaneous	.....
Fabricating	28,200	Tool & Die	73,900
Sand Storage	3,000	Foundry, Machine Repair	188,000
Glass Plant	1,361,470	Ore Bridge	132,000
Cement Plant—Melt	146,000	Miscellaneous	689,240
Cement Plant—Grind	.....	Total Kw. Hr. Cons.	19,710,540
Stone Screening	12,200		

STEAM OUTPUT IN LBS.

Power House No. 1	515,760,000
Power House No. 3	79,300,000
Power House No. 10	.....
Total Steam Produced	595,060,000
Total Compressed Air Produced	392,520,000

Remarks:

STEAM CONSUMPTION IN POUNDS

Coke Ovens	40,420,000	No. 1—P. H.	320,217,605
Blast Furnaces & Pig Cast	84,947,209	No. 3.—P. H.	42,766,220
Electric Furnaces	.....	Construction Fabricating	3,961,577
Foundry Melting	10,525,000	Glass Plant	1,330,039
Foundry Machining	29,238,795	Cement Plant	3,610,000
Jobbing Foundry	4,753,886	Paper Mill	2,976,000
Motor Assembly	17,875,000	D. T. & I. Shops	5,791,600
Tractor—B. Bldg.	7,394,935	Miscellaneous	10,321,155
Body Plant & Dry Kiln	5,817,320	Foundry	3,115,659
		Total Steam Consumed	595,060,000

POWER HOUSE NO. 1

PULVERIZERS NO. 1 TO 12

Total Mill Hrs.	2,643	Tons of Coal Pulverized	13,867
Mill Capacity	6-Tons	Tons of Coal Conveyed System A	.....
Tons of Sea Coal	623	Tons of Coal Conveyed System B	.....
Tons of Coal Received	13,331		

COAL COMBUSTION

Total Coal in Pounds	25,960,000	B. T. U. in Coal	13,867
Total Gas Equivalent in Pounds Coal	18,239,806	Moisture in Coal in %	3.
Total Tar Equivalent in Pounds Coal	5,105,662	Ash in Coal in %	7.2
" " in gallons	.....	Efficiency %	81.3
Total Evap. lbs. Steam per lb. Coal	10.42		
Total Evap. at 212°F.	11.4		
Average CO_2 in %	15.2		

STEAM CONSUMPTION IN POUNDS

Turbo-Generators	241,528,000
Average Vacuum on Generators	28 in.
Turbo-Blowers	73,080,000
Average Vacuum on Blowers	28 in.
Auxiliaries	37,464,305
Evaporators	34,330,000
House Sets	6,895,200
Heating in P. H. No. 1	.....
Foundry	24,316,000
By-Products	40,420,000
Cement Plant	3,610,000
Blast Furnaces	.....
High Line	15,367,000
Misc. Heating	38,749,495
Total Steam Cons.	515,760,000

LOG OF OPERATION

Boiler No.	1	2	3	4	5	6	7	8
Steam Pressure	244	245	242	243	244	245	244	.....
Steam Temperature	585	No Record	No Record	587	615	624	628	.....
Steam Flow in 1,000 Pounds	119,390	89,340	40,980	123,430	34,320	41,530	66,770	.....
Furnace Temperature	2,370	2,178	2,255	2,244	2,347	2,249	2,161	.....
Uptake Temperature	562	500	615	568	610	584	556	.....
Furnace Draft	0.24	0.28	0.23	0.32	0.24	0.26	0.31	.....
Uptake Draft	1.49	1.30	1.55	1.46	1.49	1.58	1.35	.....

Total Steam in Pounds.....515,760,000

Total Hp..... 17,074,098 Average Hp. in 24 Hr.....22,546

Make Up to Hot Well, Total Gallons.....	No Record	G. P. M.	.....		
Make Up to Evaporators, Total Gallons.....	7,052,720	G. P. M.	158		
Boiler Feed Water to Boilers, Total Gallons.....	65,701,910	G. P. M.	14,711	Temp. F.....	250

Remarks:

Turbo Blower No.	1	2	3	4	5
Hours in Service	672	.....	672	.....	.....
R. P. M.	2,644	.....	2,721	.....	.....
Volume Cu. Ft. in 24 Hrs.	36,000	.....	38,000	.....	.....

FIG. 11 TYPICAL MONTHLY LOG OF POWER HOUSE OPERATION

How Good Lighting Benefits the Shop

Data by Which the Plant Manager Can Measure the Relative Effectiveness of His Factory Illumination

By A. G. ANDERSON

Research Engineer in Industrial Management, University of Illinois

OF 445 plants studied in a recent survey made by the American Engineering Council, only 8.7 per cent were found to be excellently lighted; 32 per cent were graded as good; 29.1 per cent fair; 18.8 per cent poor; 3.5 per cent very poor; and 7.8 per cent partly good and partly fair.[1] In spite of the facts that the modern industrial worker often accomplishes more with his eyes than with his hands, and that 25,000,000 of the 40,000,000 gainfully employed men and women suffer from defective vision,[2] over 90 per cent of the manufacturing plants of the country, if the above survey is typical, still neglect one of the first and most important requisites for profitable production.

Eight states have adopted industrial lighting codes establishing minimum standards, but solely from the standpoint of the workers' welfare.[3] It is not the province of government to make laws to increase profits. That is the manufacturer's responsibility. Fortunately, he does not have to conduct his own research, unless so minded, for an American Standard code of lighting has been prepared which gives him complete information on the best modern practice.[4]

The factory manager is impelled toward good lighting because of its immediate practical effects, such as:[5]

1. Reduction of accidents
2. Greater accuracy in workmanship
3. Decreased spoilage of product
4. Increased production for the same labor cost
5. Less eye-strain
6. Better working and living conditions
7. Greater contentment of the workmen and less labor turnover
8. Better order, cleanliness and neatness in the plant
9. Easier supervision of the men

The number of industrial accidents increases as the use of artificial lighting is increased, both during the day and in succeeding seasons. See Fig. 1.[6] Investigations in England showed that 25 per cent more accidents occurred during winter months than during summer months, and 74 per cent more accidents due to persons falling. In the shipbuilding and foundry industries, and among dock workers the accident rate doubled. These trades have notably bad lighting.[7] In the United States one out of four accidents was formerly occasioned by faulty illumination, but only one out of every eight may be attributed to that cause now.[8] Nevertheless the annual loss arising from this cause would probably total the services of over 100,000 men for a year. Substantial savings may be effected in accident insurance costs by an improved accident record, sometimes amounting to as much as $5 to $10 per workman, annually. Elimination of accidents due to inadequate or improper lighting is simply a matter of purchasing the proper equipment, and installing it under competent directions.

Good lighting may be considered as a master tool which facilitates the use of productive equipment. It very definitely lessens fatigue, for, as normally the eye consumes from 10 to 15 per cent of the total energy expended by the body, eye-strain greatly hastens physical exhaustion. Perhaps 25 per cent of spoilage would be eliminated by good lighting, which in the aggregate would amount to about $30,000,000 annually. Good lighting in all the manufacturing plants of the country would probably result in at least a 10 per cent increase in total production, valued at about $4,500,000,000 annually.

Good lighting requires three things:[9]

1. Light of Suitable Quality
   - a. Absence of glare
   - b. Absence of reflected glare
   - c. Proper color
2. Light of the Proper Direction
   - a. Shadows soft and luminous
   - b. Uniform distribution
3. Light of the Correct Intensity
   - a. Lighting for safety
   - b. Lighting for production
   - c. Proper maintenance

Glare represents one of the most common and serious

[1] Eastman, R. O. *Transaction of the Illuminating Engineering Society*, v. 15, no. 1.

[2] See *The Journal of the National Educational Association*, November 1922. "Eye Sight as a National Problem," by Guy A. Henry.

[3] New Jersey, Pennsylvania, New York, California, Oregon, Wisconsin, Ohio and Massachusetts. Many others have some regulations concerning lighting.

[4] "Code of Lighting for Factories, Mills and Other Work Places." Illuminating Engineering Society, New York, N. Y. Approved by the American Engineering Standards Committee.

[5] "Code of Lighting for Factories, Mills and Other Work Places." Council of National Defense.

[6] From The Travelers Standard, v. 3, no. 10, p. 211. The Travelers Insurance Company.

[7] First Report of Committee on Lighting in Factories and Workshops. (London).

[8] "Light, Sight and Safety." Address by R. E. Simpson, Engineer, Travelers Insurance Company. Delivered before the Eye Sight Conservation Council of America (1924).

[9] From a pamphlet entitled, "What an Industrial Lighting Salesman Should Know." National Lamp Works of the General Electric Company.

faults in a lighting installation. It may be defined as any excessive brightness within the field of vision. It causes (1) discomfort and fatigue, (2) interferes with clear vision, reduces efficiency and increases the risk of accident, and (3) tends to injure the eye and cause a disturbance of the nervous system. The principal causes of glare are (1) excessive brightness of the light source, (2) too great a volume of light, (3) excessive contrast with background, (4) specular reflection from the object on which the eye is focused, and (5) time of exposure.

The human eye is capable of adapting itself to illumination of intensities varying from less than a ft.-candle (few hundredths) to a maximum outdoor daylight of 10,000 ft.-candles. With the entire field of view of the same brightness the eye will function efficiently and without strain over a range of 4 to 4000 ft.-candles. With a contrasting field of view, however, contrast ratios should preferably not exceed 1 to 100, and at most 1 to 200. Outdoor ratios are commonly not over 1 to 25. The most common and troublesome cases of glare are those which are due to unshaded or inadequately shaded lamps or improperly placed lighting units within the field of view. Sky brightness rarely exceeds 3 candles per sq. in. and ordinarily the brightness of a lighting unit in the field of vision should not be greater than 2 to 5 candles per sq. in. of apparent area, and the brightness should be reduced to ½ candle per sq. in. of apparent area when the unit is constantly in view.

Background

In order to avoid too great contrasts the background should be well illuminated. Stippled or mat finishes on walls and ceilings eliminate the glare attending smooth finishes. The ceiling and upper wall surfaces may be finished in light colors in order to reflect most of the light which strikes them, but the lower portions coming within the normal range of vision should reflect less than 50 per cent, if they are not to produce discomfort. Ceilings of "mill-white" or cream color, and upper walls of buff, light green or grey reflect about the proper proportions, while the lower parts may be of darker colors.[10]

Where local lighting units are used on fine work it is particularly important that the general illumination be good. Reflected glare can usually be eliminated by changing the position of the light source, of the work, or by decreasing the brightness of the light source. Glare due to "time of exposure" can be corrected by decreasing the brightness of the light source or shifting the position of the workplace or worker.

Natural daylight varies somewhat in quality, but artificial light within daylight quality ranges will be found generally satisfactory. Mazda lamps have been developed which modify the light given out, and due to the fact that all the light rays are emitted from the light source used, it is possible by the use of suitable screens to secure the color or quality of light desired. These screening properties may be incorporated in the glass of the bulb. For instance, the Mazda C-2 lamp gives a light which approximates in quality that of afternoon sunlight. Ordinarily the light from Mazda B or Mazda C lamps serves very satisfactorily without modification, although the light rays are not in the same proportion as in daylight.

The mercury arc light as developed by Peter Cooper Hewitt is the only unnatural illuminant in extensive use. The light produced by the glowing mercury vapor contains practically but three colors: yellow, green and blue, of which the yellow and green constitute 90 per cent of the effective light. A very un-

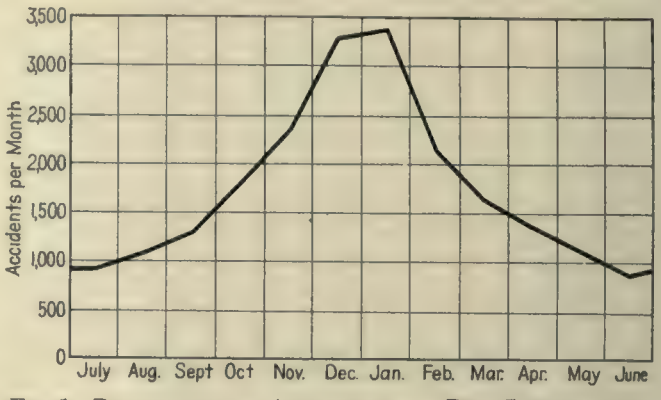

FIG. 1 DISTRIBUTION OF ACCIDENTS FROM POOR ILLUMINATION

natural bluish cast is given to objects, and most colors appear distorted. The preponderance of yellow-green rays enables the eye to focus instantly for this particular color and secure a perfectly sharp image which is not blurred by the presence of light rays of other colors. In this way it is superior to daylight. Its particular advantages are the greater clearness of vision which it gives in the discernment of fine details, the lessened fatigue and eye-strain, freedom from

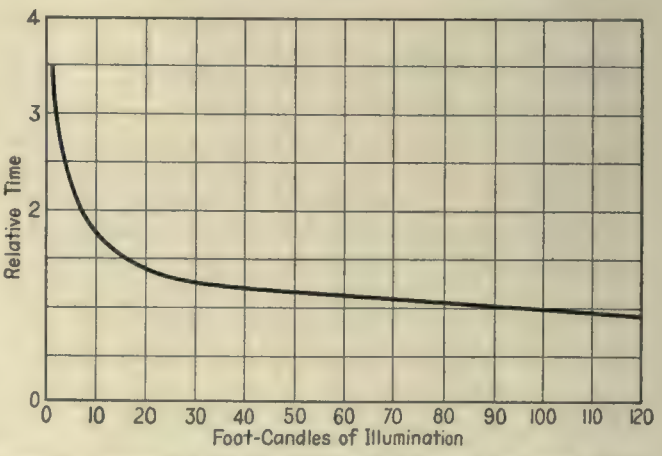

FIG. 2 INTENSITY OF ILLUMINATION AFFECTS REACTION TIME

glare, absence of dark shadows and coolness of the light. It has been used in the Bureau of Engraving at Washington for over 17 years, and quite widely in many industries, as newspaper plants, printing establishments, textile mills, machine shops, foundries, tire factories, automobile body plants, etc.

Light direction and the management of shadows constitutes an important phase of industrial lighting.

[10] See "Management's Handbook," p. 341, Table 34, for reflecting power of various colors.

Shadows are as desirable in most cases as the proper degree of light, but they must be of the proper density and rightly placed, i.e., natural. They are an aid to visual perception of objects with three dimensions, except when they become so sharp or so dark as to make it difficult to distinguish between shadows and objects, and to perceive detail. Without them objects would appear flat.

Artificial illumination has usually been designed with first thought for horizontal working planes and with the assumption that enough illumination would thereby be provided on oblique and vertical planes. This has been the cause of much deficient illumination. In machine shops, assembly departments, textile mills and for innumerable other industrial processes, the illumination of other than horizontal planes is most important, and needs to be provided for to the extent of 50 per cent to 100 per cent of that supplied on the horizontal plane. The R. L. M. standard dome porcelain-enameled metal reflector provides 50 per cent as much illumination on the vertical plane as on the horizontal; hence, if more is desired, the lamp power will need to be increased proportionately.[11]

Another factor in effective lighting is the redirection of the light rays by reflection from ceiling, walls, stored materials and equipment, and the sizes and proportion of room areas. Reflected light helps to eliminate dark shadows and produces a more uniform illumination.

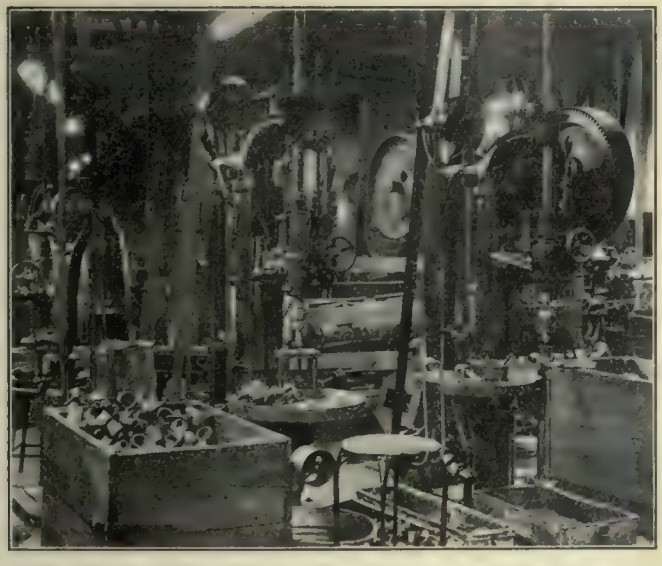

FIG. 3 GOOD LIGHTING IN HILL PUMP AND VALVE PLANT

The practice of painting machinery a standard grey or sand color rather than black, which absorbs almost all the light it receives, aids in this.

Light of the Proper Intensity

In lighting for safety the American Standard code gives the requirements in Table 1 for light intensity, with the warning that the specifications are not to be interpreted as sufficient to insure good lighting.

[11] The deep-bowl, prismatic-glass reflector, special industrial unit gives 55 per cent; the deep-bowl, mirrored-glass reflector, 45 per cent; the large, shallow-bowl, porcelain-enameled reflector—lamp fitted with shield or cap of metal or opal glass—45 per cent, etc.

For good lighting there are four general levels of illumination which the operating executive will do well to keep in mind:[12]

5 ft.-candles—Satisfactory for work of a coarse nature, such as rough assembling, rough packing, coal and ash handling, and the like, where the eyes are not called upon to see small details quickly and accurately. This value also would represent an abundance of light for warehouses, stockrooms, and aisles and passageways which were always kept free from obstructions. Enough light to dispel any sense of gloom.

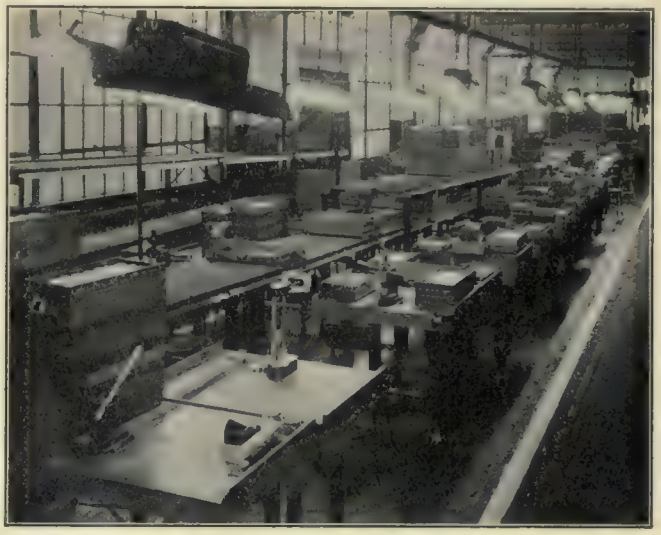

FIG. 4 MERCURY VAPOR LIGHTS IN A. C. SPARK PLUG PLANT

10 ft.-candles—Considered good lighting for most kinds of work on light colored surfaces, and for fairly close work on dark surfaces. Not enough light for examining fine details on dark, light-absorbing surfaces.

15 ft.-candles—Really excellent lighting. In addition to permitting quick and accurate execution of all work except the most exacting, lighting of this kind stimulates the workman and makes for fast and accurate production.

50 to 100 ft.-candles—The upper range of artificial lighting values as judged by present experience. Necessary only in extremely fine, accurate operations and in inspections of very fine details. Usually employed locally and supplemented by general lighting of lower value.

Outdoor daylight in the shade on a sunny day will approximate 500 ft.-candles; the average factory interior artificially lighted only two or three. Recent laboratory experiments show that the minimum intensity of illumination required for maximum visual efficiency is between 10 and 20 ft.-candles, and this under the most favorable conditions with respect to glare and contrast.[13] Fig. 2 shows the relationship between intensity of illumination and reaction time.[14] A somewhat greater acuity of vision at a given intensity results from the use of monochromatic light as supplied by the Cooper-Hewitt mercury vapor lamp.

[12] "Factory Lighting Designs." Bulletin No. 42-A, p. 7. Engineering Department, National Lamp Works of the General Electric Company.

[13] See *American Journal of Psychology*, January 1922. "Comparative Cognitive Reaction Time With Light of Different Spectral Character, and of Different Intensities of Illumination," by Martha Elliott.

[14] See *American Machinist*, February 19, 1925, pp. 295-300. "Lighting Facts to Ponder Over," by C. E. Weitz.

TABLE 1. LIGHTING REQUIRED FOR SAFETY*

PLACE OR CONDITION	MINIMUM FT.-CANDLES ON THE SPACE OR AT THE WORK
Roadways; yard thoroughfares	0.02
Storage spaces; aisles and passageways in workrooms excepting exits and passages leading thereto	0.25
Where Discrimination of Detail is Not Essential	0.5
Spaces, such as: Hallways, stairways; exits, and passages leading thereto; toilet rooms; elevator cars and landings. Work, such as: Handling material of a coarse nature; grinding clay products; rough sorting; coal and ash handling; foundry charging.	
Where Slight Discrimination of Detail is Essential	1.0
Spaces, such as: Stairways, passageways and other locations where there are exposed moving machines, hot pipes, or live electrical parts. Work, such as: Rough machining; rough assembling; rough bench work; rough forging; grain milling.	
Where Moderate Discrimination of Detail is Essential	2.0
Work, such as: Machining; assembly work; bench work; fine core making in foundries; cigarette rolling.	
Where Close Discrimination of Detail is Essential	3.0
Work, such as: Fine lathe work, pattern making; tool making; weaving light colored silk or woolen textiles; office work; accounting; typewriting.	
Where Discrimination of Minute Detail is Essential	5.0
Work, such as: Watchmaking; engraving; drafting; sewing dark colored material.	

* "Code of Lighting," p. 3, Illuminating Engineering Society, New York, N. Y.

Fig. 3 shows good machine shop lighting in the plant of the Hill Pump and Valve Company, of Chicago. The irregularity in type of equipment and its arrangement, the belting and overhead shafting, however, all tend to interfere with light distribution and make areas of this kind difficult to light uniformly with proper intensities.

Fig. 4 shows the use of mercury vapor lights in combination with daylight in assembling the jewels and speed cups for speedometers in the plant of the A. C. Spark Plug Company, Flint, Michigan. The engineer in charge says:

We find that the Cooper-Hewitt light gives us the best satisfaction on fine or highly polished materials, as it has a tendency to bring out the defects with less eye-strain to the operator, even more so than daylight. It is a practice on some of the operations that are very particular, to use the mercury vapor lamp at all times, as we find that the light from the windows, even on a clear day, changes in intensity, and coming from only one side casts shadows on the work and gives a little poorer inspection than we get with the artificial light. We are using light at about 30 ft.-candles.[15]

In the Detroit Piston Ring Company plant a careful test extending over a period of 15 months showed the results of increased intensities of illumination as indicated by the chart in Fig. 5.[16] The original installation consisted of individual lamps on drop cords with an illumination intensity of 1.2 ft.-candles. This was changed to a general lighting system with successive increases in illumination to 6.5, 9 and 14 ft.-candles, respectively. Lighting costs increased 48 per cent, but this represented only 2 per cent increase measured in terms of the monthly payroll. Production increased from 70 per cent to 83 per cent and finally to 96.3 per cent, a total of 25.8 per cent.

[15] From a letter, dated June 10, 1925, received by the writer from the A. C. Spark Plug Company, and signed by E. Kelly, electrical engineer.

[16] See *Factory*, February 1923, p. 148, "How Better Lighting Increased Our Production Twenty-five Percent," by John Magee, President of Detroit Piston Ring Company.

In a roller bearing plant tests were conducted over a period of 10 weeks to note the effect of increased illumination on production.[17] The results were:

Illumination in Ft.-Candles	*Increase in Production, Per Cent*	*Cost of Light in Per Cent of Payroll*
5.0 (old lighting)		0.3 per cent
6.0	4.0	0.8 per cent
13.0	8.0	1.6 per cent
20.0	12.5	2.4 per cent

The McGraw-Hill Company, book publishers, have a lighting installation giving 20 ft.-candles; while in the

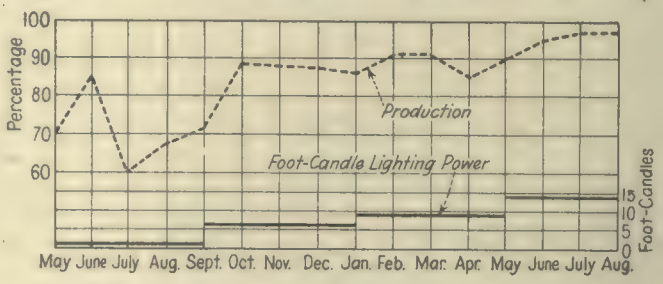

FIG. 5 EFFECT OF IMPROVED ILLUMINATION ON PRODUCTION IN DETRIOT PISTON RING PLANT

body finishing department of the Fisher Body Company, of Detroit, an intensity of 50 ft.-candles is used.

Daylight intensities may be as great as 125 ft.-candles a few feet inside of large windows. The average range, however, is from 4 to 50, with many places more poorly lighted. Outdoor intensities for the various hours of average days during the months of

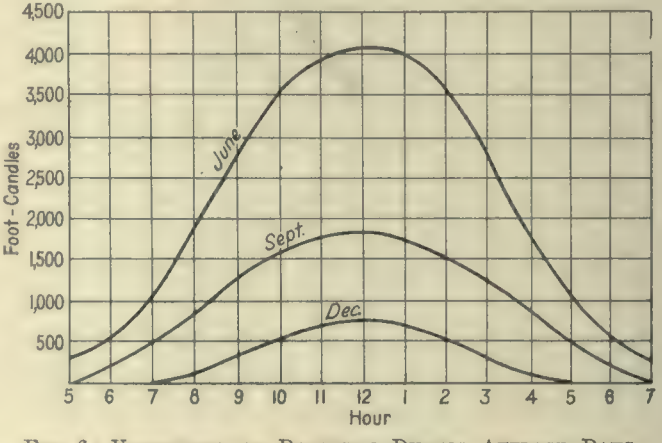

FIG. 6 VARIATIONS OF DAYLIGHT DURING AVERAGE DAYS

June, September and December are indicated in Fig. 6,[18] Lighting codes recommend that daylight intensities of illumination need to be twice as high as those recommended for artificial light. Adjustable translucent screens, Venetian blinds, or shades may be used to cut off direct sunlight and protect against glare; or for some places a coat of whitewash on the windows during the summer months may answer.

(To be continued in the December issue.)

[17] See *Transactions of the Illuminating Engineering Society*, November 1923. "The Relation of Illumination to Production," D. P. Hess and Ward Harrison.

[18] "A Survey of Natural Illumination in an Industrial Plant," by C. E. A. Winslow. U. S. Public Health Report, 1922, v. 37, part 1, pp. 876-887.

Group Premium for an Automatic Screw Machine Department

By L. J. HOULIHAN

Industrial Engineer, Ritter Dental Manufacturing Company, Inc.

THE purpose of every wage incentive plan is to increase production and decrease costs, at the same time offering a reward to the workmen in the form of higher earnings if they assist in bringing about this result. In other words, the wage plan is a means to discover, measure and utilize in a manner equitable to all, the potential productivity of every operator.

At first glance, an automatic screw machine department would seem to lend itself most readily to a straight piece-work plan or, in some cases, to individual premium. After a careful analysis of all conditions it will be seen, however, that group premium has advantages possessed by none of the others previously mentioned, while the disadvantages of the former are eliminated. Group premium can be made to function whether the plant has continuous production or manufactures for stock; whether the operators both set up and operate, or whether set-up men and job tenders are employed.

The experience given in this article is with an automatic screw machine department in which the set-ups are not on premium and the men both set up and operate the machines. The basic principles of a group premium plan are not affected by these conditions.

Disadvantages of Individual Premium

Before pointing out the advantages of this group premium plan, it is well to examine the disadvantages of the individual premium. In the first place, individual premium or straight piece work is unfair to a great many operators. An operator on a No. 00 Brown and Sharpe machine, on which the production per hour is great, will undoubtedly have shorter runs than an operator working on a larger machine. As a result, the former is spending more time setting up than the latter. This condition does not give him the same opportunity to earn premium and is consequently unjust. This same condition arises with operators running the same type of machine, one of them working on steel and the other on brass. The brass jobs, running considerably faster, will tend to give more trouble than the steel and will also in the majority of cases be shorter runs.

It can be argued that a good foreman would so lay out the work for his department that all men would be given the same opportunity. Such a foreman is a rarity, for it is only human nature for a man to take a greater interest in some of his men than in others. He can, unconsciously and without intending to show favoritism, give a few the chance of making more premium at the expense of the rest of the department. This always causes dissatisfaction and will affect the smooth running of any organization.

Much available production which could easily be taken advantage of is lost and unnoticed under an individual plan. If an operator has a group of, say, four machines, and has them running, he promptly finds a comfortable spot and spends his time watching them work. His reasoning, and he is justified in it, is that when setting up he is costing the company money, but that with all his machines going, he is producing to his limit and no objection should be registered if he sits down and does nothing. Then, too, he is satisfied for he is making enough premium and has not the least interest in the rest of the department. He could spend part of his time aiding someone else, but there being no incentive, he does not do it.

When an operator is setting up a machine, one or more of the other machines he has running is likely to be out of stock. This machine will run idle and lose production, which at times is considerable, until noticed by the operator. Rarely under individual premium does he get any assistance from his co-workers when a situation like this arises. When an operator is late or absent the company loses production for that period, and the only way this is eliminated is by good supervision. Under group premium, as will be pointed out later, this condition is taken care of.

Allowance for Premium

Before any actual time study is undertaken, the per cent per machine to be allowed for premium must be established. This requires careful analysis of conditions and the determination of the number of machines an operator can set up and operate with a minimum of idle machine time. If the order quantities are small, an operator can handle fewer machines than if they are large, consequently requiring a larger premium allowance per machine. The complexity of the work is another deciding factor. An operator can handle more machines on simple cut-off and form work than if intricate cross-slide and turret attachments are used. If a standard of three machines is set, requiring that an operator should both set up and oper-

ate, then the total premium allowance for the three machines should equal the allowance given on hand operations in the other departments. For instance, if a 30 per cent premium allowance is used on hand operations and three machines is the standard number of machines for an automatic operator to handle, then the premium per cent per automatic machine should be 10 per cent.

In a plant in which the writer was instrumental in the installation of a group premium system, the following conditions existed. The plant manufactured parts for stock and assembled to order. Men who were capable of setting up and operating were employed, some of them proficient on several different makes of machines, to provide for flexibility in the department. The class of work ran from simple cut-off operations to those requiring the use of cross-slide attachments, revolving turret attachments and a few magazine feed jobs. The time to machine an order quantity ran from around 4 to over 75 hours.

Standard Times

The first step in every wage incentive plan installation is the determination by scientific job analysis and time study of the time required to perform a given operation. With an automatic machine, this appears to be very simple but a clever automatic operator can, if the observer is not equally clever and alert, easily deceive the observer as to the machine's capacity on a given operation.

In the determination of the standard time on an automatic, the job analysis depends on whether the cams are bought from the machine maker, made by the company's toolmakers, or are standard cams. If the cams are bought from the machine maker, the observer should see that the maker's specified production is at least equalled and, wherever it can be done safely, should be increased. Where the company makes its own cams, the following procedure can be followed to advantage. When the cams are tried out before hardening, the tool division should notify the time study department so that the latter may have an observer on hand to check the production and be satisfied that the speeds and feeds used by the toolmaker are the maximum that can be safely maintained. On machines using standard cams the operator should be familiar with standardized speeds as set down by the company. The chart, Fig. 1, gives this information. The heavy zig-zag lines show the surface speed at which several materials of any size should be machined and the revolutions per minute required to machine the piece at this surface speed.

For instance, with a ¼ in. bar of cold drawn screw steel, start at the ¼ in. division and move horizontally until the cold drawn screw steel line is intersected. Then moving vertically, it will be found that the revolutions per minute to be used will be between 1500 and 1600. It must be remembered that these spindle speeds are subject to variation and change with conditions, but the chart offers a standard at which to aim.

The observer then checks the feeds used and should see that they give a maximum of production with a minimum of tool trouble and tool grinding. The idle time of the machine should next be studied and reduced to a minimum by decreasing as far as possible the travel of tools in approaching work.

When the observer is satisfied that conditions can not be bettered, the actual time to make a piece is noted and to it is added time to permit stocking the machine at the end of each bar. The allowance for premium, which was previously determined, and allowances for tool trouble and other contingencies are added to this time. The last-mentioned allowances vary according to conditions and should be given careful consideration by the observer, as his judgment and experience decide these.

Premium Formula

This result is the standard time allowed for the operation and which, if bettered, earns premium for the group.

Example:

A = Standard time per piece	1 minute
B = Pieces in order quantity	600 pieces
C = Standard time for order quantity $\frac{(B \times A)}{(60)}$	10 hours
D = Actual time taken for order quantity	8.5 hours
E = Premium earned for group (C − D)	1.5 hours

The payroll department cumulates the premium earned on all jobs during the week, to get the total premium earned by the group. This is then distributed to the individual operators according to the number of hours worked by the group and the number of hours worked by the individual. This is more equitable than it would be if the premium earnings of the group were divided by the number of men in the department, because when an operator is late or absent, he does not share in the premium earnings of the department. He participates only for the actual number of hours he worked, figured as follows:

Operator's share of premium:

$$\left(\frac{\text{Actual hours worked by operator}}{\text{Total hours worked by department}}\right) \times \left(\begin{array}{c}\text{Total premium}\\ \text{earned by dept.}\end{array}\right)$$

On the form, Fig. 2, the cost department makes out a report of the premium earnings and forwards it to the time clerk in the department. He then makes out slips for each individual operator, informing him of his premium earnings for the week.

Advantages of Group Premium

Are the disadvantages under individual premium overcome under group premium and does group premium possess advantages possessed by no other plan? In the first place group premium is equitable to every operator. Under piece work and in many cases with individual premium all operators in the department have the same base rates, the premium being on productivity alone. With group premium these rates should be adjusted so that the men who

Diam. of Stock Inches	Revolutions per Minute																																Material
	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	
1/16												10	11	11	12	13	14	15	16	16	18	20	22	22	24	26	28	30	32	32	34	36	38	40	Chrome Ni
3/32										10	11	12	13	14	15	16	17	18	19	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	Tool Steel
1/8									11	12	13	15	16	17	18	19	21	22	23	24	27	30	32	34	36	38	42	44	46	48	51	54	57	60	
5/32								11	13	14	15	17	19	20	21	23	24	26	27	28	31	34	38	40	42	46	48	52	54	56	59	62	65	68	* See Note
3/16						10	11	13	15	16	18	20	21	22	25	26	27	29	31	32	36	40	42	44	50	52	54	58	62	64	68	72	76	80	
7/32						11	13	14	17	18	20	22	24	26	28	29	31	33	35	36	40	44	48	52	56	58	62	66	70	72	76	80	84	88	
1/4					10	12	14	16	18	20	22	24	27	29	31	33	35	37	39	40	44	48	54	58	62	66	70	74	78	80	84	88	92	96	C. D. Steel
9/32					11	13	16	18	20	22	25	27	29	32	34	36	38	40	43	44	50	54	58	64	68	72	76	80	86	88	94	100	104	108	Soft Bronze
5/16					12	15	17	19	22	25	27	29	32	34	37	39	42	44	46	50	54	58	64	68	74	78	84	88	92	100	104	108	112	116	
11/32				10	13	16	18	21	24	26	29	32	35	37	40	43	45	48	50	52	58	64	70	74	80	86	90	96	100	104	110	116	122	128	
3/8				11	14	17	20	23	26	29	31	34	37	40	43	46	49	51	54	58	62	68	74	80	86	92	98	102	108	116	119	124	131	136	
13/32				12	15	18	21	24	28	31	34	37	40	43	46	49	52	55	58	62	68	74	80	86	92	98	104	110	116	124	128	136	141	148	
7/16			10	13	16	20	23	26	30	33	36	39	43	46	49	52	56	59	62	66	72	78	86	92	98	104	112	118	124	132	137	144	152	156	
15/32			11	15	18	23	25	29	33	37	40	46	48	51	55	59	62	66	69	74	80	92	96	102	110	118	124	132	138	148	160	164	171	184	
1/2			12	16	20	25	28	32	37	41	45	49	53	57	61	65	70	73	77	82	90	98	106	114	122	130	140	146	154	164	171	180	189	196	Yellow Brass
17/32			13	18	22	27	31	37	40	45	49	54	58	63	67	72	76	81	85	90	98	108	116	126	134	144	152	162	170	180	196	196	214	216	
9/16		10	15	20	24	30	34	39	44	49	54	59	64	69	74	78	86	88	93	98	108	118	128	138	148	156	172	176	186	196	206	216	236	236	
17/32		10	16	21	26	32	37	42	48	53	58	64	69	75	80	85	90	95	101	106	116	128	138	150	160	170	180	190	202	212	222	232	242	256	
5/8		11	17	23	28	34	40	45	52	57	63	69	75	80	85	91	97	103	109	114	126	138	150	160	170	182	194	206	217	228	239	252	263	276	Aluminum
19/32		12	18	24	30	37	43	48	55	61	67	73	80	86	91	96	104	110	116	122	134	146	160	172	182	192	204	220	232	244	256	268	280		
1/2		13	19	26	32	39	46	52	59	65	72	78	85	92	98	105	111	118	124	130	144	156	170	184	196	210	222	236	249	260	273	286			
21/32		14	22	29	35	44	51	59	66	71	81	88	95	103	108	118	123	132	140	142	162	176	190	206	216	236	246	264	280	284					
5/8		16	24	33	41	49	57	65	74	82	90	98	106	115	123	131	139	147	155	164	180	198	212	230	246	262	278	294	310						
23/32		18	27	36	45	54	63	72	81	90	99	108	117	126	135	144	153	161	170	180	198	216	234	252	270	288	306	322							
3/4	10	20	30	39	49	60	66	78	88	98	108	118	128	137	147	157	167	176	186	196	216	236	256	274	294	314									
25/32	11	21	32	43	53	64	74	85	96	106	117	127	138	149	160	170	181	191	202	212	234	254	276	298	320										
7/8	11	23	34	46	57	69	80	91	103	115	125	137	149	160	172	183	194	206	217	230	250	274	298	320											
29/32	12	24	37	49	61	74	86	98	110	122	135	147	160	172	184	196	208	220	232	244	270	294	320												
1	13	26	39	52	65	78	91	104	118	130	144	157	170	183	196	209	222	236	249	260	288	314													
1 1/16	15	29	44	58	71	89	103	116	132	142	162	178	191	206	221	232	247	264	279	284	324														
1 1/4	16	32	49	65	82	98	115	130	147	164	180	196	212	230	246	260	276	294	310	328															
1 3/16	18	36	54	72	90	108	126	144	162	180	198	216	234	252	270	288	306	324																	
1 1/2	20	39	59	79	98	118	138	158	177	196	216	236	256	276	296	316																			
1 5/16	21	43	65	86	106	130	148	172	191	212	233	260	281	296	317																				
1 3/4	23	46	69	92	114	138	160	184	206	228	251	276	299	320																					
1 7/8	25	49	73	98	122	146	172	196	221	244	269	292	317																						
2	26	52	78	105	131	157	183	210	236	262	288	314																							
2 1/16	28	56	83	112	139	167	195	224	252	278	306																								
2 1/4	29	59	88	118	148	177	206	236	265	296	325																								
2 3/16	31	62	93	124	155	186	217	248	279	310																									
2 1/2	33	65	98	131	163	196	229	262	295																										
3	39	78	118	157	196	236	275	314																											
3 1/2	45	91	137	183	228	274	319																												
4	52	105	157	210	262	314																													
4 1/2	59	118	177	236	295																														
5	65	131	196	262	327																														
6	78	157	234	314																															
7	91	183	273																																
8	105	210	315																																
9	118	236																																	

* Note:
Phos. Bronze
Cast Iron
Ni. Steel Malleable Iron
Drop Forgings
Hard Bronze
Hy-Ten.

FIG. 1 SURFACE CUTTING SPEED AND REVOLUTIONS FOR VARIOUS MATERIALS

maintained the quality standards, who were the most skillful and the biggest producers before, will have the higher rate. This should be done; if not, the large producers will feel that their premium is going to the rest of the department. In reality it is, but their high base rate keeps them in the front rank so far as weekly pay is concerned, at the same time an incentive is given them to speed up the slow operators and thereby increase their own earnings. Productivity alone should not establish the base rates, but careful attention should be given to the following qualifications:

1. Quality
2. Versatility
3. Productivity
4. Cooperation
5. Length of service

Under group premium, no matter whether an operator gets short or long runs, whether he gets steel or brass jobs, whether he gets cut-off jobs or complicated ones, he knows that these conditions affect the entire group and not him alone. The foreman can give out jobs to the men he knows are best capable of handling them, without in any way being accused of showing favoritism, for one man's gain is the department's gain. He can also, when he has time, help out his men on set-ups or on minor repairs, thereby winning their cooperation very easily by showing he is willing to help them. If he did this, in any individual plan, he would be accused of favoritism unless he helped every operator alike. In a plant that has no foreman's bonus it would be very advantageous to pay him a bonus based on the departmental production. He would dig in and do far more than he ever would on a straight salary.

DEPT. No. 4 DATE Week, July 11

% PREM. FOR DEPT.

Oper. No.	Operator's Name	Hrs. Worked	Prem. Hrs. Earned	Total Hrs. Pd. For
401		48.	13.09	61.09
402		39.3	10.71	50.01
403		43.5	11.86	55.36
404		48.	13.09	61.09
405		48.	13.09	61.09
406		48	13.09	61.09
	Total	274.8	74.93	349.73

FIG. 2 REPORT OF PREMIUM EARNINGS

Lost production due to an operator failing to notice a machine out of stock is minimized under group premium, for every man is watching out for every machine in the department instead of one man taking care of his own group.

If an operator has his machines all running, under group premium he will help someone else either to set up or tend the latter's machines until the latter completed his set-up. Production again is increased by this speeding up of set-ups that was not obtainable under individual premium, for then there was no incentive.

When an operator is late or absent, group premium has a far more serious effect on him than any other plan. He loses his hourly rate and his share of premium for the length of time he was out, which is approximately the same as his loss would be under individual premium. The real loss comes when he has, say, four machines running at the time he lays off. The foreman or the other operators start them up and by exerting themselves a little can take care of them. This increases their earnings at the expense of the absentee and in many cases leaves machines to be set up by the operator when he returns. After this has happened a few times he usually thinks twice about laying off for a day. This condition gives to the company production that it would otherwise lose.

A poor operator under group premium is either going to increase his knowledge and become more skilled, or else be gradually crowded out. With individual premium, the weeding out of the drones is left to the foreman and in many cases he keeps men on his force that in reality should be let out. Under group premium the condition changes, for no group of men will let part of their earnings go to a man who is not doing an honest day's work.

Results of Group Premium

The main advantages having been set forth, let us now look at the results. Are the men satisfied? Their chief concern is the pay envelope and with that rests their approval or disapproval. It has been the writer's experience that under group premium the operators' earnings surpassed consistently their peak point under individual premium. That they are satisfied is apparent.

Does the company benefit? In the plant where the writer aided in installing group premium, there existed what was considered to be a smooth working individual premium plan. At the outset group premium warranted a 30 per cent decrease in personnel. This reduced force not only got out the same production as formerly but also was able to take care of a very substantial increase in schedule.

In the final analysis group premium achieves results unobtainable under any other plan. It has discovered productivity in operators that no other system could; it has measured it; and finally it has so utilized this productivity that both operators and management realize the efficacy of the plan and are in absolute concord in registering their approval.

A High Substation

THE substation of the Pittsburgh Plate Glass Company at the Creighton, Pennsylvania, plant is restricted on a narrow section of land between mountain and river to a width of only 20 ft. The company's foresight two years ago in providing for a height of four stories, to allow expansion upward that was not possible outward, is now justified. The capacity has recently been doubled without difficulty.

Electrical Power Costs

Analysis of How to Avoid Maximum Demand Charges

By DONALD ROSS-ROSS

Mechanical Engineer

THE cost of purchased electrical energy is an important item in certain industries, when a large amount of current is consumed. Under this circumstance the chief engineer must study the factors governing the fluctuation in the cost per kilowatt hour on his electrical bills, so that he may make intelligent recommendations for power betterments and institute the changes.

First of all is the consideration of power factor which is most acute where large numbers of induction motors are used, especially if these are run under unfavorable conditions. The most suitable method to rectify these conditions is by the use of overexcited synchronous motors, or by static condensers.

The loss due to poor power factor is shown by Fig. 1, which is based on a penalty for a power factor less than 85 per cent. The curve is calculated on:

$$\frac{85\%}{\text{actual power factor}} \times \text{kw-hr. consumed} = \text{kw-hr. charged} \quad (1)$$

The chart, Fig. 2, drawn from formula (2) gives a convenient and easy method of following the power factor from day to day, week to week, or month to month, in order that the penalty may be reduced to a minimum or to avoid being penalized at all. The formula is:

$$\text{Power factor} = \frac{1}{2}\sqrt{\frac{(1+x)^3}{1+x^3}} \quad (2)$$

where x = ratio of the consumption on the two meters on the power lines, being greater than unity.

Possibly the most complex problem facing the engineer is that of load factor. It is not only involved from the engineering point of view, but draws in also the factor of economic plant operation.

An Example: Take, for example, a contract existing between a manufacturing concern and a power company in which the basis of charge is as follows:

A charge of $1 per month per horsepower of maximum demand; a charge of 1½ cents for the first 50 kilowatt hours per horsepower of maximum demand; a charge of 1 cent for the second 50 kilowatt hours per horsepower of maximum demand; and ¾ cent for the remaining kilowatt hours consumed. To summarize this:

Maximum horsepower demand × $1	=
Maximum demand × 50 kw-hr. × 1½ cents	=
Maximum demand × 50 kw-hr. × 1 cent	=
Balance of kw-hr. consumed × ¾ cents	=
Plus meter rental	=
Total	=

To make the example concrete, let us assume that the maximum demand is 2412.8 hp., 370,000 kilowatt hours consumed and the meter rentals amount to $7 per month, then:

2412.8 hp.	× $1	= $2412.80
2412.8 × 50 kw-hr. = 120,640	× 1.5 cents	= 1809.60
2412.8 × 50 kw-hr. = 120,640	× 1.0 cents	= 1206.40
Excess to balance = 128,720		
370,000	× ¾ cent	= 965.40
	Meter rentals	= 7.00
		$6401.00

This example gives a mean rate of 1.73 cents per kilowatt hour. However, it can readily be seen that

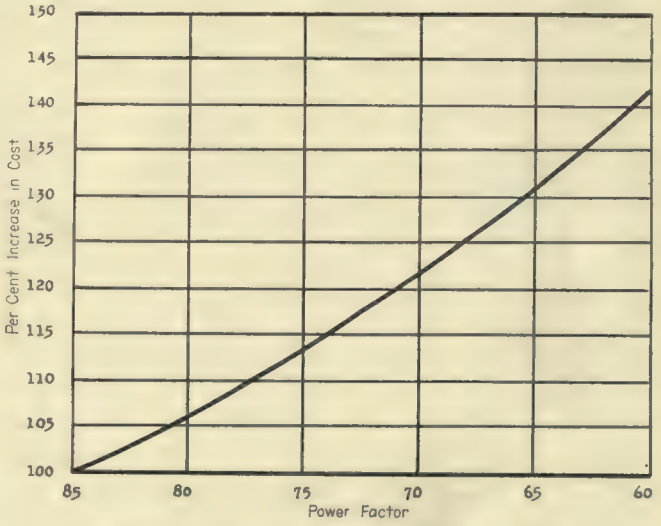

FIG. 1 LOSS DUE TO POOR POWER FACTOR

with an increased or decreased consumption of power, the maximum demand remaining the same, there will be a corresponding decrease or increase cost per kilowatt hour, respectively. This is self-evident as there will be a greater or lesser excess chargeable at the ¾ cent rate. We cannot stop at this point and draw a curve depicting this increase or decrease unit cost for there is still the factor of maximum demand which is by no means a fixed quantity.

Should we attempt to couple up the demand with the consumption, we will obtain some sort of ratio, thus eliminating two variables. To do this, conditions must be brought to the same basis.

First of all, the horsepower maximum demand has to be reduced to kilowatts. Taking the total number of hours in the month and multiplying by the kilowatt

of demand, we get a quantity in kilowatt hours. This would be the consumption of power if every motor were loaded to an amount equal to the maximum demand and run continuously throughout the month under this condition. The actual consumption is only a fraction of this amount, and that fraction is known as the "load factor." What effect load factor has on the cost per kilowatt hour is best seen by the curve of Fig. 3.

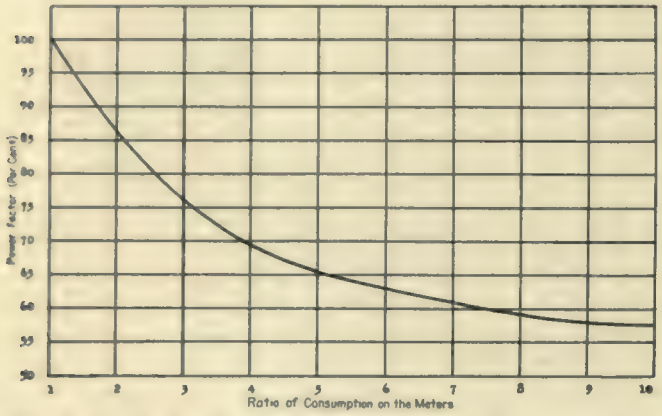

FIG. 2 POWER FACTOR CURVE SHOWING RATIO OF CONSUMPTION ON THE METERS

In nearly every instance, a maximum demand once established remains to stay until the expiration of the power contract, if not in whole, at least in part. That is, if in one month the demand reaches 2500 hp. and in any subsequent month falls to 2000 hp., the basis of billing of the latter is not on the 2000 hp., but on 2250 hp. where a minimum of 90 per cent of established maximum demand only is permitted. Therefore, a close watch on the power company's demand meter or graphic watt hour meter is essential.

The effect of an increased demand is twofold on the power bill. It increases directly the charge of $1 per horsepower of demand; but not only that, it increases the amounts chargeable at 1½ cents, and 1 cent or any other set of rates in effect and, hence, decreases the balance at the ¾ cent or low rate.

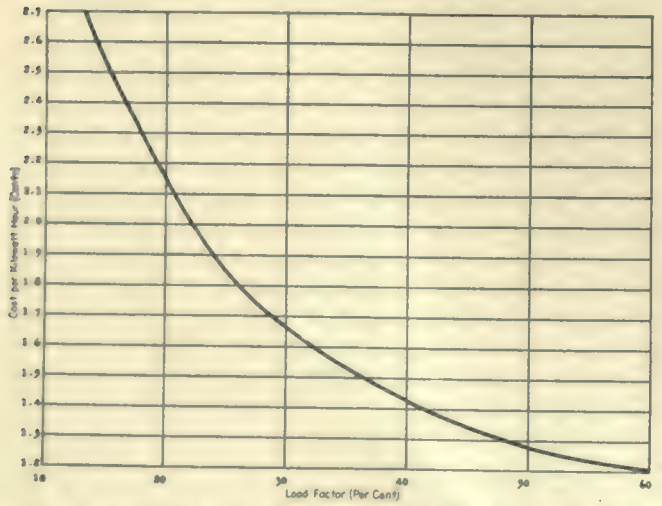

FIG. 3 EFFECT OF LOAD FACTOR ON COST PER KILOWATT HOUR

Taking the basis of charge as used in the previous example, and assuming the kw-hr. consumed as 370,000 with an increasing demand from 1206.40 hp. to 2412.80 hp., a curve, Fig. 4, will be obtained. This curve gives an excellent idea how power costs are augmented through high maximum demands.

The figures are naturally not applicable to any localities other than at the place of writing, where fairly cheap power is available in a country of abundant hydroelectric development, but they serve to point out what characteristics must be looked out for in purchasing power.

Due to the many intricate phases of the power problem, it becomes a very difficult task for a factory manager and his chief engineer to decide on what loading of the electrical equipment, or night working of at least a portion of the plant is most economically sound. Having made a decision prior to the signing of a new contract, it then becomes necessary to guard against overstepping the demand decided upon.

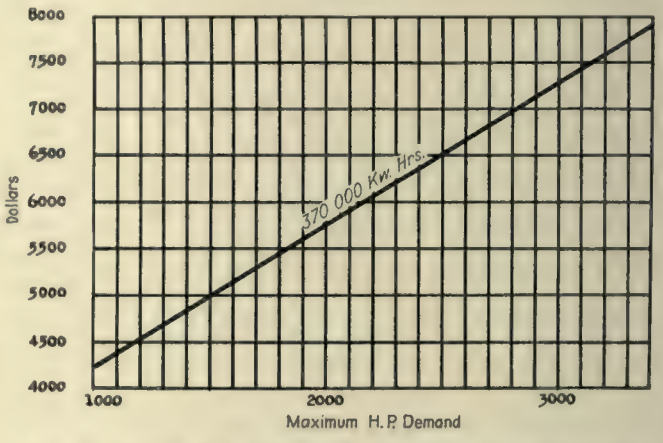

FIG. 4 EFFECT OF INCREASING DEMAND WITH CONSTANT CONSUMPTION ON THE POWER BILL

Various methods can be employed depending on conditions in the sub-station. Where a sub-station operator is employed, he may be required to keep a constant watch on the load, either by the power company's demand meter or graphic watt hour meter. This man should then have authority to trip a portion of the plant when the load shows signs of exceeding the predetermined maximum. Where no such operator exists, a time interval high peak alarm might be installed to ring a bell at such machines that demand a large portion of power and can easily be unloaded by the operators when the alarm is sounded. Home-made devices for automatically tripping any desired circuit can also be easily made and installed.

The devices should be so designed as to allow a lapse of time of about 66 per cent of that on which the maximum demand is based; otherwise the alarm or tripping would become incessant and a nuisance. That is, if the demand is based on 15 minutes, then the alarm should sound after 10 minutes had elapsed.

In these days of keen competition and necessity for low manufacturing costs, the engineer can make substantial savings in the operation of his department by following methods such as have been suggested.

Making a Success of the Small Manufacturing Business

III. How to Sell The Product

By C. U. CARPENTER

WHAT is the underlying idea in modern management anyway? Why is it a great tool to get things done? Questions like these are real and for them there are honest-to-goodness answers.[1] Many a manager with a feeling of despair has said something like this:

"Instead of always telling me what *has* happened, why don't you fix your systems so that you can tell me what *should* happen so that I can *make* it happen? It doesn't do much good to tell me what *has* happened for I can't help it, and when I try to find out who is at fault I get so mixed up over the alibis that I am told that I can't blame the right man anyway."

There, in a nutshell, is the real principle of modern production: Find out what should happen and make it happen. That is, determine what your standards should be in every department, be it production or system, and take steps to secure those standards. There is the secret of Ford's system. He and his organization know what standards should be attained before they start; then they take steps to make certain that these standards are attained, right from the start.

As an example: Instead of finding out that a certain product costs a larger amount than anyone imagined and then struggling for months to find some way to reduce these costs, you determine through the cost analysis as shown, what should be produced on each operation on every part and how much it should cost. Then, using these data as a guide, you can force your production to reach the standards so set.

The average man does not like to attend to all these details. But underlying every one of your business activities is the question of the cost of your product. You can't get away from it. It affects the amounts of your payrolls, your sales policies, and your profits. Therefore any man is a fool who will not get after and keep after this question of cost and production surveys until it is whipped.

The Modern Principle of Manufacture

When I was a young fellow with a superficial knowledge of all the known systems ever written about, I had a rough-spoken boss who taught me the primary lesson about modern manufacture without knowing the real force of his remark. In my youthful eagerness I would frequently bob into his office full of enthusiasm because my system had disclosed the fact that John Jones, check #346, had cost the company 87 cents because of scrap or some other cause. Of course, it probably cost the company $2.87 to find it out. But I didn't bother about a little thing like that. I had the loss by the back hair. After I had sprung the effectiveness of my systems on him about ten times, he said wearily, "Charlie, you're a nice boy and I like you. But when you run in here telling me all the time what *has* happened it makes me think of you dragging a dead dog in here by the tail."

The most important thing for you to do is to get this analysis of each and every part showing the list of operations and the output that you have the right to expect from each one of them. Then it is your business to see that you get these outputs. If you base your selling prices upon costs determined in this manner you are then sure of your profits if you have figured your overheads properly. But you have to see that your outputs are up to the standards that are so determined.

In passing, let me say that there is no better procedure for the man running an established business, who may be up against the problem of reducing costs, than to have exactly the same survey made of each of his products, thus ascertaining what his production and costs should be and then making these come to this predetermined standard.

Selling Methods and Costs

Don't leave the sales plans until the last. The tendency is to dig out of your designing and manufacturing problems and let the selling plans and estimates of selling costs go until the last thing. This is often due to that mistaken idea that the product will sell itself.

There is no greater mistake. You must not fool yourself here. If the product is something new on the market, the public will be slow even to show interest in it. To you, the product is so valuable that you cannot see how it can be hard to sell. But the slow-thinking, disbelieving public will not take it up until it is coaxed, persuaded, almost driven to it. This costs money.

If the product is a competitive one, you may reckon on a long period of disappointment before you get a real volume of sales. The public prefers a well-known standard article or, at least, one that is sold by a

[1] See MANAGEMENT IN MANUFACTURING, September 1925, pp. 125-128, October 1925, pp. 195-198.

company in which it has confidence. It must feel that it is buying from parties who, it knows from long experience, will stand back of the line. Do not forget this point, for herein lies one of the principal advantages of having reputable dealers handle your line, especially at first. You will get the benefit of their good-will and reputation built up through years of honest effort.

In considering the manner in which you will market your goods you will think of:

1. Selling through your own branch houses.
2. Selling through jobbers.
3. Selling through direct house-to-house canvass.
4. Selling through dealers.

The following points are worth considering:

Selling through Branch Houses. Branch houses directly representing the company are expensive to maintain. They require large working capital. Their overhead is heavy, much heavier than the overhead of a dealer who will spread it over 40 or 50 articles while a branch house must spread it over the one article.

The branch house salesmen must go out and hunt up the customers. As the average time spent by the salesman in actually facing his prospect is only 7 per cent of his total time, you can see that he will not interview many prospects during a day.

The dealer's store will have a steady run of customers all day long in addition to the men that he has out interviewing prospects.

With the branch store you can better control your selling methods, and, with the same floor space, can probably sell more of your product than the dealer can. But it costs you far more, and therefore, as it is "the dollar that's left" that we are all after, you will naturally consider these points.

Sometimes a product requires so much repairing, due to damage in shipment or due to servicing, that a branch store is necessary. This must be considered seriously, for you cannot get a dealer to attend to servicing if it is complicated or continuous. Here comes in the condition that I mentioned under "Designing."[2] Often this is the fault of the design. Therefore, faulty design may force upon the company an expensive selling system.

Selling through Jobbers. This may appear to be a simple way of selling. However, there are serious objections to it. You are in the hands of your jobber. You lose your sales identity with his customers, for he controls them. Some fine day, when things are going swimmingly, Mr. Jobber drops your line for some other that will pay him a bigger discount, and there you are, without a sales organization and no market that you are identified with.

You will often have to make concessions that are not fair. You will have to allow a heavy discount so that the jobber may quote the proper discount to his dealers. The worst feature is that you cannot come into contact with the dealers that really sell your lines and hence you have no way of getting them to adopt your sales policy, that may be needed in order to market your line properly.

Selling through Direct Representation. This plan may be successful with certain lines that carry the proper appeal, but it cannot be adapted to the needs of the men who read these articles. It may sell silk stockings but is not to be used with articles of a mechanical nature unless they are of the household variety. Even then there is much doubt if this plan has any advantage over the selling through a high-grade, established dealer. Possible service always enters the mind of the customer and he feels safe in buying from a dealer in his home town.

Selling through Dealers. For a business just starting out, it's hard to beat the plan of selling through established dealers. Of course it has to be done properly to get the desired result. The old haphazard method of getting dealers and then letting them struggle with their own difficulties in selling your line naturally will not get you the sales you think you ought to have.

It is a great advantage to get the benefit of a dealer's good reputation when entering the market of any town. You try it with your own store and you will find that there is a long, costly period of doubt and suspicion to undergo. Your dealer already has that desired reputation and his customers will buy your product from him readily and freely because of the reputation that it has taken him years to establish. Let's look this plan over.

Selecting the Dealers

The old plan—and it is still prevalent—was to send your salesman to a town to "get a dealer." Upon his arrival he gets out the telephone book, lists up the dealers, and begins. He has no more idea of their credit than a rabbit. He roams around and finally establishes one. Of course many dealers will buy anything and sign any contract to get a line of goods. But will they pay for them?

The dealer hears nothing further until the goods arrive. There is no one around to tell him the merits of the goods. He doesn't know how to sell them. His clerks know less than he does. The customers are not going to ask for them. Finally the products that you are so proud of and that you thought were going to sell so quickly, find their way to a shelf in the back of the store and the only interest that the dealer has in them is to get you to take them back and to refuse to pay your bill. I have been all through this myself and I know the results.

The Proper Dealer Plan

First get a reliable list of possible dealers in your line. You can get trade lists that are fair. Personally I prefer to get them out of Dun's or Bradstreet's rating book. List them up by towns and put down their credit ratings.

I prepare a list for each and every town of 10,000 and over population in the United States. Later I go to 5000 and less. Each town has a separate sheet containing the names and credit ratings of each dealer.

[2] In the September issue.

I begin first with those towns and cities that are in the states nearest the factory. I then pick out the dealers I can afford to deal with.

A month before the traveling representative calls upon the dealers of any town, the advertising begins, so that by the time the salesman arrives, the dealers are familiar with the product to a certain extent.

The salesmen are thoroughly trained in proper methods of presenting our proposition before they ever leave the factory. When they arrive in a town they know whom to see, the way has been prepared for them, and they know how to handle the proposition. When they get a dealer, they get a good one.

After you have had some experience you will learn the amount of stock that a man ought to carry in view of the business to be had from any particular town, considering the amount and quality of population. Do not over-sell a dealer, even though he may wish to purchase heavily. Remember that you must get and hold his confidence and to do that you must not persuade him to over-buy.

After you get the dealer, then begins your actual work in arousing his enthusiasm for your goods. There is only one thing that will wake him up and keep him awake, and that is that he make a good profit on your line. You have got to help him make a profit. If he does that, the rest will largely take care of itself. If he doesn't make money on your product, all the follow-up letters in the world will not keep him alive.

Every dealer has certain lines that are his mainstay—that help to pay his rent and salesmen. If you can get your goods within that circle of products that are easily sold and are profitable, then you are headed aright. But you will have to help him at first. You, in your enthusiasm for your product, know that it is the greatest thing for the public and the dealer on the market; but they do not know it.

The average dealer resents efforts to train his salesmen in the art of selling and he is seconded by the body of clerks. So, while this has to be done, it must be put over in a diplomatic manner. I can only touch upon the methods to be used in a brief article such as this. But your traveling representatives must make it their business to help the dealer sell the line and must train the sales force in the proper methods to sell it.

While I am a strong believer in advertising, still I think that there are large sums wasted here. Do not start national advertising until the factory is ready to produce in proper amounts, and until you have a wide-spread sales organization. Where you are dealing with dealers I think it best to divide your advertising into:

1. Advertising to interest and *get* the dealer.
2. Advertising to keep the dealer enthused.
3. Advertising to his customers.

Keep in mind, however, that a well thought out system of selling must be devised and planned thoroughly long before you get the shop started. This severe problem must be attacked early in the game and must not be left until toward the last because you harbor the delusion that your precious goods will sell themselves.

Patents

Here is the place of all places where we insist on believing what we like to believe. Just let us get a patent and we shut our eyes to the possibility of our infringing upon someone else and being closed down just about the time that we are getting ahead.

Yet we all know that the government does not and, indeed, cannot guarantee the strength of a patent. It makes its careful searches and examinations, and gives us the best guarantees that it can, but it often requires a court to decide the close points.

A patent search is of great importance. It is a costly affair though, and many a man starting in business cannot stand it. Do it yourself then in the best way that you can. Get all of the patents in your particular art and go through them with the greatest care. It's a long and tedious job, but it pays richly. The examination makes you familiar with the art of the industry. You will find many a pitfall that you must avoid. Make a report upon each one as you go through them. When you can afford it, get a competent patent attorney to check up your findings.

Capital

This all-important subject cannot be treated comprehensively here. There are a few points, however, that we ought to cover, for many a man spoils a fine enterprise by leading himself and others forward upon false premises.

He underrates his need of capital, goes ahead, absorbing too much in expanding too rapidly, and finally finds that his pet has, after a lot of hard work, gone into the control of others.

When about to start into an enterprise, list up those places where capital will be absorbed before you get any return, calculate the amounts needed, and do not forget to include a large amount for the building up of parts to fill up the shop properly before you begin real assembling. This may include designing, building a model, securing the patent and getting the patent search, designing and building tools, bringing through and testing the article, buying material and getting the factory organization ready, testing tools, and starting production—which involves the sinking of a surprising amount of capital into purchases and payrolls before you get any return. Most men overlook the fact that you have to have sufficient materials not only to keep up ample supplies, but also practically to keep every job in the shop well filled to keep up the steady flow of parts to the all-important assembling department.

Of course no set of rules can be laid down for the successful promotion and carrying through of any enterprise, for there are so many varying conditions, but I believe that in the main these ideas are useful.

But, above all things, search for the facts in every nook and cranny, and when you find them, look them squarely in the face and meet and conquer them.

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 100 magazines; it also includes the publications of some 50 book publishers and professional societies so far as these are of managerial interest to manufacturing executives. The number at the right of each item is the index symbol according to the Dewey Decimal Classification System. If articles are clipped and filed according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. The books and pamphlets indexed can be procured from the Management Publication Corporation or from their respective publishers. Photostat copies (white printing on black background) of any magazine article indexed can be obtained at a *price of 25 cents the page*, by addressing the Engineering Societies Library, 29 West 39th Street, New York City. Remittance must accompany the order. When ordering photostats please quote from the index: (1) Title of article; (2) Index number; (3) Name, date, and page numbers of periodical in which the item appears. The editors will be glad to furnish on request additional information in regard to the management of manufacturing industries, and on industrial buildings and equipment.

Industrial Buildings and Plant Maintenance

Buildings and Equipment

Best Plant for Candy Making—III. 658.23
Morgan G. Farrell. *Candy Factory*, Oct. 1925, pp. 89-90. Illus. Type of structure to build. Elevators and toilets, sash, floors, painting.

Features That Distinguish a Good Lighting System. 658.242
Roy A. Palmer. *Industrial Engineer*, Oct. 1925, pp. 476-478, 506-507. Illus. Factors that must be considered when planning a lighting installation.

How Good Lighting Benefits the Shop. 658.24
A. G. Anderson. MANAGEMENT IN MANUFACTURING, Nov. 1925, pp. 277-280. Illus. Data by which the plant manager can measure the effectiveness of his lighting system. Examples of production increases brought about by good illumination.

Lighting Systems, Like Machinery, Must Be Kept in Good Condition. 658.242
Automotive Industries, Sept. 24, 1925, pp. 512-516. Illus. Description of several systems of factory lighting, with emphasis upon correct illumination as a production factor ranking with men and tools.

Modern Floorings and Floor Replacement. 658.58
Building Investment and Maintenance. I—Sept. 1925, pp. 13-16. Illus. A study of rubber tile and strip flooring for offices, entrances, etc. Methods of laying and cleaning. II—Oct. 1925, pp. 13-18. Illus. Plain and decorative linoleum, its adaptability, selection, laying and maintenance.

The Modern Manufacturing Plant. New Hall Planetary Company Plant Represents Marked Advance in Lighting, Heating and Power Transmission. 658.2
J. R. Thomas. MANAGEMENT IN MANUFACTURING, Nov. 1925, pp. 261-264. Illus. Actinic glass for best daylight, new scheme of industrial heating, novel construction of steel work to provide for power transmission and material handling equipment, are among the features which make this plant well worth study by executives contemplating new construction.

Peerless Cement Mill at Detroit in Active Production. 658.2
E. S. Hanson. *Cement, Mill and Quarry*, Sept. 5, 1925, pp. 9-18. Illus. Description of new plant and its equipment.

Maintenance and Repair

Analysis of Machine Tool Maintenance. 658.581
A. R. Kelso. *Society of Automotive Engineers Journal*, Oct. 1925, pp. 385-388. Machine repair analysis methods at the Continental Motors Corporation, where a comprehensive study has been made and a maintenance budget system has been put into effect.

Progressive Maintenance. 658.58
Fred M. Sharp. *Society of Automotive Engineers Journal*, Sept. 1925, pp. 278-279. What can be accomplished by an adequate policy definitely followed.

General Management and Policy

Administration and Policy

Earthquakes and Insurance. 368
Dwight Ingram. *Pit and Quarry*, Oct. 1, 1925, pp. 90-92. Rates, and what the policies cover. Necessity and advantages of this type of insurance.

Financing the Sale of Automobiles. 658.882
Henry G. Hodges. *Automotive Manufacturer*, Sept. 1925, pp. 5-8, 26. Operation of partial payment plan; functions and advantages of finance company.

Principles of Corporation Finance. 658.14
Harold L. Reed. Houghton-Mifflin Company, Boston. 412 pp. $2.60. Deals with the principles of corporation finance. Intended for college classes. Follows through the life of the business corporation, from inception to dissolution. The first part deals with the financing of a new enterprise, the second with current operations, the third with the handling of earnings, the fourth with the growth and expansion of projects, and the fifth with failure and reorganization.

What Is Going to Happen to the Small Manufacturing Plant? 658
Dale S. Cole. *Industrial Management*, Sept. 1925, pp. 173-177. Illus. Co-operation is replacing destructive competition. Specialization will help small plants. Present industrial tendency is toward decentralization.

Economics

Industry's Partner—the Community. 33
John A. Piquet. *Industrial Management*, Sept. 1925, pp. 183-187. Illus. Manufacturers find relief from pressing problems through better local conditions and civic co-operation.

Labor and Wages in Europe. 331
W. Irving Bullard. *Stone and Webster Journal*, Sept. 1925, pp. 301-320. Illus. Conditions in important countries.

Labor Economics. 331
Solomon Blum. Henry Holt and Co., New York. 579 pp. $4. Traces the processes of standardization and valuation set up by the labor movement. Discusses: Origin of the labor movement; meaning of freedom; class legislation; labor legislation in the United States; legal status of trade unions; the right to strike; social insurance; unemployment and its mitigation; the business cycle; settling industrial disputes; industrial peace; forms of unionism; its monopolistic tendencies and its tactics; conflict of interest; wages; wider program of the labor movement; and an estimation of the collectivist program.

Labor Problems. 331
Edgar S. Furniss, with the collaboration of Lawrence R. Guild. Houghton-Mifflin Co., Boston. 621 pp. $2.80. A text book for the study of labor problems, drawing its materials from many sources, the data from which are united by co-ordinating sections prepared by the authors to form a connected course of study. Subjects treated are: Problems of the modern wage-earner—unemployment and its remedies, wages, hours of work, woman and child labor, and industrial accidents; organized labor—its development, forms, economic program, social and political problem, and the industrial conflict; agencies of industrial peace—conciliation, mediation and arbitration; modern industrial relations policies—profit and ownership sharing, employee representation.

Labor Relations in Industry. 331.15
Dwight Lowell Hoopingarner. A. W. Shaw Co., Chicago. 553 pp. Flexible binding. $6. Treats labor relations in industry as a whole. Analyses the problems involved, shows the trend of developments in policy and organization, and gives suggestions for handling administrative problems in labor relations. No standardization of methods or mechanisms is believed possible nor desirable but principles of equity can and should be followed. In 8 parts: 1—A point of view in labor relations; 2—Control of labor relations; 3—The division of earnings; 4—Working periods and labor supply; 5—Health conservation; 6—Special social considerations; 7—Local plant relations; 8—World scope and trends. Appendix is made up of case problems to crystallize and show the practical application of material presented.

Machine-Tool Needs of the Automotive Industry. 338.4
R. M. Hidey. *Society of Automotive Engineers Journal,* Oct. 1925, pp. 359-360. Single and multi-purpose machines, safety measures, co-operative effort, expenditure for development, standardizing and balancing.

What the Coal Commission Found. 338.2
Edited by Edward Eyre Hunt. Williams & Wilkins Company, Baltimore. 411 pp. $5. Gives in easily readable form much of the fact matter, conclusions and recommendations of the last U. S. Coal Commission, of which John Hays Hammond was chairman. The point of view is very evidently that the government should exercise control over this type of private business. Divided into 4 sections, the first dealing with the coal problem as a whole; the second devoted to bituminous mining; the third to anthracite mining; and the fourth to the recommendations of the Commission. Issued at an opportune time, during another of the periodical labor disturbances in the mining fields.

Wholesale Prices 1890 to 1924. 338.5
U. S. Dept. of Labor, Bureau of Labor Statistics Bulletin No. 390. 252 pp. $0.35.

Management

Building Good Will. 650.6
H. T. East. *Public Service Management,* Oct. 1925, pp. 117-118. Work of the Public Service Co. of Northern Illinois.

Effective Letter Filing System. 651.53
Beno Farenwald. *Railway Mechanical Engineer,* Oct. 1925, pp. 619-620. Numerical classification makes finding easy under all conditions, in Chicago, Milwaukee & St. Paul master mechanic's office.

Efficient Tool Designing System. 621.75
Frank H. Mayoh. *Machinery,* Sept. 1925, pp. 29-30. Illus. Study of part to be made is followed by list of operations required, then tools and fixtures are blocked out and finally detailed drawings are made.

Graphical Charts as an Aid to Time Study. 658.5421
E. C. Van Orsdell. *Industrial Management,* Sept. 1925, pp. 141-149. Illus. Types for use in estimating to eliminate work of calculation.

Making a Success of the Small Manufacturing Business—III. 658
C. U. Carpenter. MANAGEMENT IN MANUFACTURING, Nov. 1925, pp. 287-289. How to sell the product, modern principles of manufacture, selling methods and costs, selecting dealers, the proper dealer plan, patents, capital.

Manual of Organon. 658
Charles W. Gremple. Organon Lyceum, New York. 32 pp. Flexible binding. $2. The philosophy and science of "organing" the art of management. A condensation of considerable material collected by the author during the last 15 years. Based on the philosophy predicted by Frederick W. Taylor. Arranged in graphic and tabular style. Devoted to proving that formal management is an art separate and distinct from all other arts, and having its own science. Proposes Gremple's Law: "Like conditions, plus like causes, necessitate like effects," as a basis.

Principles and Methods of Statistics. 311
Robert Emmet Chaddock. Houghton-Mifflin Co., Boston. 471 pp. $3.75. An introductory text for general use in colleges and universities. Presents the subject to beginners by use of simple illustrative materials, developing elementary principles of statistics so as to logically appeal to the student. Divided into three parts, the first dealing with preliminary considerations, the second with classification and description of mass data, and the third with the gathering and presentation of statistical data.

Reorganization of a Small Factory. 658.5
Geoffrey C. Brown. *American Federationist,* October 1925, pp. 887-897. Methods used at the Jacques Kahn, Inc., plant.

Skillful use of Management Tools. 658
MANAGEMENT IN MANUFACTURING, Nov. 1925, pp. 249-250. Systematized manufacturing procedures pay. Results of budgeting, employee suggestions systems, payroll systems, tool control, production control, and a differential wage payment plan.

Power Generation and Transmission

Power Plant and Equipment

Electric Power in a Cement Works. 621.3
World Power, Oct. 1925, pp. 225-228. Illus. Description of equipment at Aberthaw & Bristol Channel Portland Cement Works, Rhoose, England.

Ford Plant Enlarges Power Capacity. 658.261
George E. Hagemann. MANAGEMENT IN MANUFACTURING, Nov. 1925, pp. 273-276. Illus. Description of 8 new 62,500 hp. turbo-generator units being installed at River Rouge. Examples of comprehensive operating logs taken.

Power Economies Through Heaters and Economizers. 658.261
Francis Juraschek. *Industrial Management,* Sept. 1925, pp. 178-182. Illus. Equipment to lighten the burden on the boiler.

Trend of Power Plant Costs. 658.26
American Appraisal News, Oct. 1925, pp. 252-253. Chart. Costs of equipment and installation, average each year, 1913 to 1925, for small industrial plants.

Power Plant Operation

Controlling Combustion of Pulverized Fuel Plants. 658.261
Engineering and Boiler House Review, Sept. 1925, pp. 120, 123-124. Illus. Types and description of operation.

Electrical Power Costs. 658.26
Donald Ross-Ross. MANAGEMENT IN MANUFACTURING, Nov. 1925, pp. 285-286. Illus. Methods of operating a manufacturing plant purchasing power, to improve power and load factors and avoid maximum demand charges.

Flow Meters in the Accounting of Process Steam. 658.26
Chapin Tyler. *Chemical and Metallurgical Engineering,* Sept. 1925, pp. 755-756. Illus. Maximum operating economy and accurate expense distribution obtained by use of control devices.

Possible Adjustment in Using Waste Heat Boilers. 658.261
Cement, Mill and Quarry, Sept. 5, 1925, pp. 27-28. Action of different coals, moisture, mudshelves, calcining.

Some Operating Figures for the Magnetic System of Unburnt Fuel Recovery. 658.261
Engineering and Boiler House Review, Sept. 1925, pp. 115-116. Illus. Data on a German installation.

Use of Grease in Modern Lubrication Practice. 621.89
Allen F. Brewer. *Industrial Management,* Sept. 1925, pp. 153-158. Illus. Essential difference between grease and oil, and where the latter is to be preferred.

Where Electricity Maintains Schedules. 658.26
F. A. Westbrook, *Electrical Record,* Sept. 1925, pp. 190-191. Illus. Electrical drive, with emergency power supply enables Ault and Wiborg plant to deliver output on time.

Power Transmission

Control of Mechanical Power Transmission. 658.2621
William Staniar. *Industrial Management,* Sept. 1925, pp. 135-140. Illus. Average methods of applying belting and appurtenances involve a tremendous waste.

Determining the Quality of Leather Belts. 658.2621
Louis W. Arny. *Industrial Engineer,* Oct. 1925, pp. 479-484, 506. Illus. Methods of finding out whether the proper quality of leather has been used for the service required.

Is Standardization of Leather Belting Practical? 621.85
Claude O. Streeter. *Belting,* Sept. 1925, pp. 32, 34. Economy and a uniform product demand standardization.

Performance Data on Belting. 658.2621
W. W. Nichols. MANAGEMENT IN MANUFACTURING, Nov. 1925, pp. 259-260. Illus. Purchase and installation of belts, and methods of obtaining power consumption of machinery by means of a portable outfit and recording wattmeter.

Use of An Improved Type of Sleeve Bearing. 658.262
J. S. Murray. *Industrial Engineer,* Oct. 1925, pp. 473-475. Illus. Conditions before and after adopting this type, and results obtained, at plant of Follansbee Brothers Co.

Marketing and Distribution

Advertising

Masters of Advertising Copy. 659.13
Edited by J. George Frederick. Frank-Maurice, Inc., New York. 392 pp. $5. Built of essays of 25 advertising writers who, in the judgment of the editor, "are or have been in the front rank of their profession." Intended to be a notable representative selection from those who have contributed the best to American advertising copy. Specimen reproductions of advertisements have been omitted with the thought of focusing the book on the principles of copy, not on its form.

Sales Went Up as Advertising Increased. 659.1
Class, Oct. 1925, pp. 29-30, 32, 34. Oak flooring manufacturers found that greater investment in space meant more business.

Purchasing and Selling

Clever Methods for Increasing Sales. 658.83
John Hertz. *Automotive Manufacturer,* Sept. 1925, pp. 23-24. Methods which brought results to Yellow Cab Mfg. Co.

Liquid Carbonic Sales Organization. 658.8
Willard J. Graham. MANAGEMENT IN MANUFACTURING, Nov. 1925, pp. 255-258. Organization, departmental managers, special sales executives, sales research and planning, customers, contract orders, exports, sales manual, conventions and contests. Annual sales total $8,000,000.

Modern Salesmanship. 658.8
J. George Frederick. Henry Holt and Co., New York. 325 pp. $4. This book on the work of the salesman, written to show "what to do" and "how to do it," is endorsed by the American Salesmen's Association, Inc., and published under the direction of that organization. The chief objective is stated to be "to inculcate and foster higher standards of salesmanship, plus a better understanding between salesmen and their employers."

National Directory of Commodity Specifications. 658.7
Department of Commerce, Washington, D. C. 379 pp. $1.25. The result of work done by the Department of Commerce to collect and publish a classified list of existing commodity specifications formulated not only by governmental purchasers throughout the United States but also by nationally recognized trade associations, technical societies, and public utilities. Information is given in regard to specifications for more than 6000 commodities arranged in a convenient form with a carefully developed decimal scheme of classification. For each specification the book tells which are in general use, by whom prepared and where copies can be obtained. In all about 27,000 specifications are indexed. This volume should be in the hands of the purchasing and specification departments of every manufacturing concern.

Psychology of Selling and Advertising. 658.801
Edward K. Strong, Jr. McGraw-Hill Book Co., New York. 468 pp. $4. Declaration of a working formula in terms of which a seller may not only make an individual sale in an efficient manner, but tend to convert buyers into customers. Deals with the possibilities of increasing efficiency of selling as a partial solution of the problem of business and industry as it is presented today. Designed to meet the needs of professional salesmen, beginners in salesmanship and those who desire a work on psychology written in non-technical language and dealing primarily with the problems of influencing others.

Selling Electric Truck Transportation. 658.8
Charles A. Ward. *Electric Light and Power.* II—July 1925, pp. 74, 76, 78, 80. Illus. III—Aug. 1925, pp. 60, 62, 64. IV—Sept. 1925, pp. 56, 58, 60, 62. Utilities profit by the charging load of electric trucks. How the sale of trucks can be boosted and the fields which they serve.

Packing and Shipping

Handling of Barrels and Casks of Pottery En Route. 658.7885
C. M. Bonnell, Jr. *Barrel and Box,* Oct. 1925, pp. 10-14. Illus. Transportation methods, loading and unloading, recoopering casks in transit.

New Package May Develop New Markets. 658.788444
Class, Oct. 1925, pp. 92, 94. How manufacturers are using attractive containers to overcome sales resistance.

Packing and Handling Barrels and Casks for Pottery. 658.7884
C. M. Bonnell, Jr. *Barrel and Box,* Sept. 1925, pp. 24-26. Illus.

Pilferproof Box Withstands Remarkable Test. 658.788444
Edwin H. Ferguson. *Barrel and Box,* Sept. 1925, pp. 41, 45. Withstands 700 drops which demolish wood but leave fasteners intact.

Selecting the Proper Container—II. 658.7884
MANAGEMENT IN MANUFACTURING, Nov. 1925, pp. 271-272. Discussion of freight rates, with comprehensive tables showing actual savings brought about by use of fiberboard and wirebound containers, and of protection against theft, container standardization, and conserving storage space.

Wooden Boxes from the Forest to the Packing Room. 674
Harry N. Knowlton. *Barrel and Box,* Sept. 1925, pp. 10-13. Illus. Felling trees, transporting logs and preparing lumber. Oct. 1925, pp. 5-8. Illus. Box-making at the General Electric plant, Schenectady, N. Y.

Material Handling and Production Control

Material Control

Economic Control of Inventory. 658.787
Joseph H. Barber, Codex Book Co., New York. 112 pp. $2. Starts with the declaration that a revolution has occurred in methods of distribution. Consumers, retailers and jobbers are now placing upon manufacturers the burden of carrying the reserves of finished merchandise. Producer must analyze his markets, study economic conditions and acquire more information in regard to distribution than has ever before been necessary. The book shows how the Walworth Manufacturing Co. has met this situation. The treatment is presentation of case material from actual experience, with charts, conclusions, forms and other exhibit material.

Mechanical Handling

Belt Conveyors in New Peerless Cement Plant. 658.281
E. S. Hanson. *Belting*, Sept. 1925, pp. 14-18, 20. Illus. These and other conveying and transmission features make layout highly efficient for production.

Conveyance of Materials—Varying Degrees of Perfection Reached in Systems Now in Use. 658.281
W. L. Carver. *Automotive Industries*, Sept. 24, 1925, pp. 484-491. Illus. Description of typical installations from Packard, Franklin and General Motors plants. The point of view is taken that arrangement of equipment is the first consideration before conveyors can be successfully applied.

How Modern Handling Was Installed. 658.281
Matthew W. Potts. *Industrial Management*, Sept. 1925, pp. 168-172. Illus. Methods and equipment of the De LaVergne Machine Co.

How Peerless Portland Cement Co. Reduced Material Handling Costs. 658.281
J. L. Langner. *Pit and Quarry*, Oct. 1, 1925, pp. 93-96. Illus. Equipment at new Detroit plant.

Latest Wagner Crushing Plant Proves Efficient. 658.281
Cement, Mill and Quarry, Sept. 20, 1925, pp. 9-14. Illus. Layout of plant and equipment, and material handling methods at the Wagner Quarries Co. plant.

Superior Portland Cement Company Operates Labor Saving Plant. 658.281
E. D. Roberts. *Pit and Quarry*, Sept. 15, 1925, pp. 45-54. Illus. Material handling and processing methods.

Transporting Sand by Aerial Tramway Over a Distance of Two Miles. 658.281
George Ransom. *Pit and Quarry*, Oct. 1, 1925, pp. 55-60. Illus. Methods and equipment at Vermont Marble Co.

Union Rock Co. Has Capacity of 500,000 Tons Monthly. 658.281
W. A. Scott. *Cement, Mill and Quarry*, Sept. 20, 1925, pp. 29-30, 32. Handling facilities and manufacturing equipment.

Production Methods and Control

All-Gas-Fired Brass Foundry. 658.27
Western Machinery World, Sept. 1925, pp. 375-376. Illus. Equipment and operating costs in the plant of the Berkeley Brass Foundry Co.

Co-ordinating Gear Design and Production Methods. 658.575
Perry L. Tenney. *Society of Automotive Engineers Journal*, Oct. 1925, pp. 372-375. Analysis of gear troubles results in development of improved design and manufacturing methods at Muncie Products Division of the General Motors Corp.

Die Castings Made of Non-Ferrous Metals. 673
Marc Stern. *Society of Automotive Engineers Journal*, Sept. 1925, pp. 254-262. Illus. Methods of operation; design, polishing, enameling and electroplating of castings; applications and limits of the process.

Inspection Methods. 658.562
C. J. Ross. *Society of Automotive Engineers Journal*, Oct. 1925, pp. 376-384. Illus. Methods at the Buick Motor Co. are highly developed and operate similarly to a budget system—a certain ratio of inspection hours to production hours being allotted in each division.

Sheet Steel Fabrication. 672
Syd Smith. *Society of Automotive Engineers Journal*, Oct. 1925, pp. 389-397. Illus. Methods in the Studebaker plant. Special provisions for utilization of scrap.

Testing of Sheet Steel. 658.772
E. F. Collins. *Society of Automotive Engineers Journal*, Sept. 1925, pp. 290-291. Limits within which material should come for deep-drawn stampings.

Testing Westinghouse Transformers. 658.562
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Employment and Training

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Personnel

Quality and Quantity of Output Depend Upon Trained Employees. 658.3
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Health and Safety

Better Eyesight Means Better Product. 658.3822
Canadian Manufacturer, Sept. 1925, pp. 12-13. Some methods of caring for employees' vision.

Reducing Foundry Accidents. 658.3823
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Survey of Hygienic Conditions in the Printing Industry. 658.382
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Remuneration

Extra Incentive Wage Plans. 658.32
Twelve booklets, 8 to 16 pp. each. American Management Association, New York. Twelve papers which, taken together, present various forms of incentive plans from sources which include: Westinghouse Elec. & Mfg. Co., Dennison Mfg. Co., Ritter Dental Mfg. Co., John Deere Harvester Works, Harder Mfg. Co., Chrysler Motor Corp., Western Electric Co., Acme Wire Co., etc.

Group Premium for an Automatic Screw Machine Department. 658.3231
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premium formula, advantages of group premium, and beneficial results of the system at the Ritter Dental Mfg. Co. plant.

How Industry Is Approaching the Wage Payment Problem. 658.323
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Charles W. Lytle. American Management Association, New York. Booklet. 12 pp. Mathematical formulas for time rates, piece rates and method of sharing time saved or lost.

Accounting and Financial Control

Accounting and Cost Finding

By-Products, Co-Products and Joint Products. 657.452
H. L. Ducker. *Journal of Accountancy,* Oct. 1925, pp. 276-285. Principle underlying the determination of costs of by-products, co-products and joint products. Simple illustrations are used to bring out features emphasized.

Cost of Distribution. 657.452
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Proper Cost Accounting for Body Builders. 657.452 (629.113)
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Financial Control

Preparation and Control of a Budget. 658.14
J. R. Tobey. National Association of Cost Accountants, New York. Booklet. 12 pp. Discussion of the work of the budget controller, length of the budget period, methods of setting up a budget, and the responsibility of everyone concerned.

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Electric Curve Drawing Instruments. 621.374
Portable, self-contained ammeters, voltmeters, and single phase and polyphase wattmeters, 110-220-550 volts, with current circuits up to 20 amperes, for alternating current. Clock or motor drive, types CP-4, and CP-5, respectively. Chart speeds of 1, 3, 6 or 12 in. per hr.; changeable by means of gear shift to in. per min., if desired. Instruments are small, light, high-torque, damped for fluctuating loads, have minimum pen friction errors, and parts are accessible. Cast aluminum alloy bearings, frame and covers. Potential circuits are in back cover, behind bakelite panels, and terminals break circuit when cover is opened, thus protecting operator from high voltages. Made by General Electric Co.

Electric Rivet Heater. 621.97
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Portable Electric Stacker. 621.87
For piling and unpiling stock. Designed on worm drive principle—worm running in oil bath—for speed, smooth operation and ruggedness. No exposed gears. Operation—up and down—through a controller. High-torque, elevator-type, 2½ hp. motor. Safety stops. Lifting speed, 40 ft. per min. with 1000-lb. load; 5 times as fast as ordinary types. Built in 1000- and 2000-lb. capacities. Known as type PB and made by the Lewis-Shepard Co.

Single Pass Steam Boiler. 621.1826
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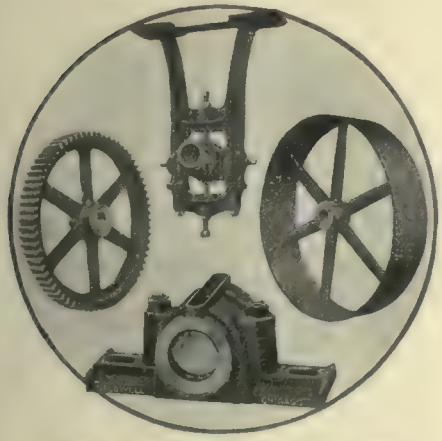

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MANAGEMENT
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MANUFACTURING INDUSTRIES

L. P. Alford, *Editor* George E. Hagemann, *Associate Editor*

Vol. X CONTENTS FOR DECEMBER, 1925 No. 6

PAGE

An Effective Production Control System . . . . . J. J. Swan 317

Material Handling Methods in the Edw. G. Budd Plant . . . . . W. A. Graf 321

The Financial and Industrial Investigation . . . . . Arthur Andersen 325

Buick Saves $100 Per Car Exported . . . . . George F. Bauer 329

Getting Rid of Idle Machine Hours . . . . . E. H. Fish 332

An Unfailing Way to Reduce the Costs of Steam . . . . . Hubert E. Collins 333

Accounting for Values or Dollars . . . . . Stephen McKenzie DuBrul 338

The Modern Manufacturing Plant 339

New Method of Indicating Fatigue . . . . . Walter N. Polakov 343

Ways of Obtaining the Best Lighting . . . . . A. G. Anderson 345

Known Costs Bring Greater Profit . . . . . Charles F. Scribner 349

Economical Truck Battery Charging 352

Methods of Protecting Shipments . . . . . C. A. Plaskett 353

Uniform Invoice Is Widely Accepted 356

The Barth Standard Wage Scale . . . . . Carl G. Barth 357

Current Information Index 358

Index to Vol. X—July to December, 1925 363

Index to Advertisers 368

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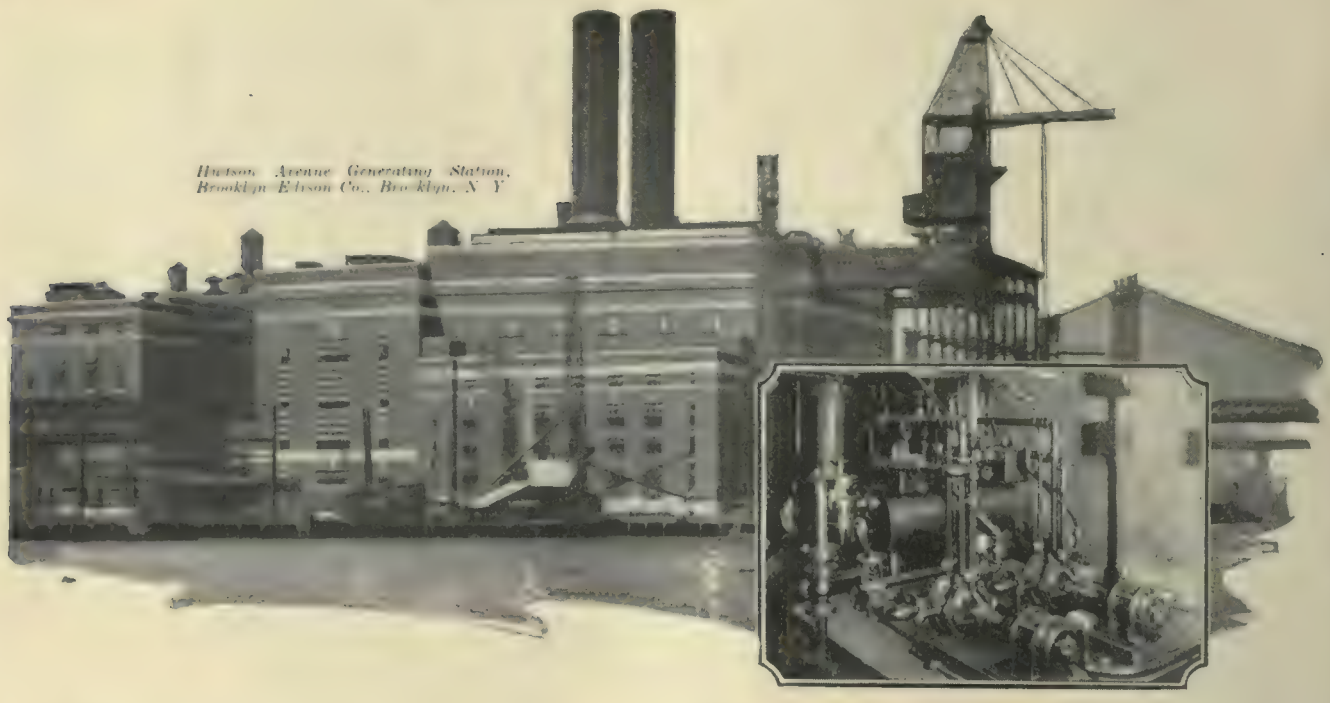

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MANAGEMENT
AND ADMINISTRATION IN
MANUFACTURING INDUSTRIES

VOLUME X DECEMBER, 1925 NUMBER 6

An Effective Production Control System

Employed in the Manufacture of Automatic Printing Presses

By JOHN J. SWAN

Mechanical Engineer

THE Kelly Press Division of the American Type Founders Company at El Mora (Elizabeth), New Jersey, is the largest factory in the world manufacturing automatic printing presses. It is also the most recently built plant for this purpose. With a considerable background of experiences in press manufacture it was to be expected that in its design, construction and equipment, this factory would be the best obtainable. In a previous issue information covering these factors is set forth in considerable detail.[1]

In this following article is described the method of production control and material procurement that this company has developed, because it represents many interesting departures from other more generally used systems. A study of much that has been published with regard to production systems, and familiarity with systems that have been tried and seriously modified or discarded, and a knowledge of the actual methods employed by many concerns in their efforts to plan production, show clearly that there is much to be desired in this field. Therefore any method that actually works continuously under practical shop conditions, holds much of interest to management, and those responsible for results.

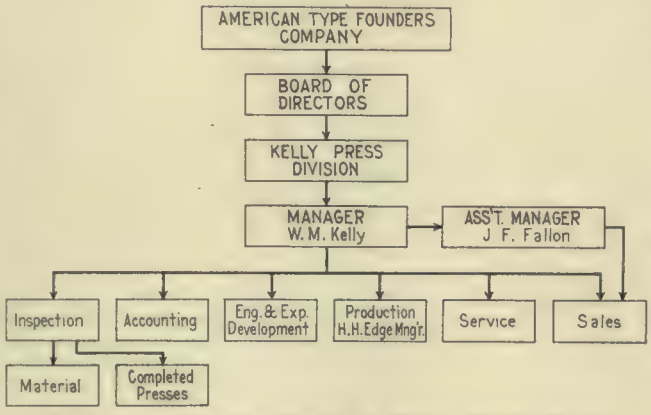

FIG. 1 ORGANIZATION CHART OF KELLY PRESS PLANT

Experience, at least from the factory end, has demonstrated that there are several systems of production control that are in general good, and have a wide range of application. There are others that have certain excellent features, and in special cases are perhaps satisfactory, but these are not generally applicable. Also there are some that are largely the dreams of pure theorists, and have little or no use in the shop, which in final analysis is a pretty practical place.

It may be stated as a fact that no system will work in any place or under any condition without understanding and hearty cooperation on the part of the management. However, a manager cannot be blamed for failure to cooperate with, or to continue the use of, a system that does not appeal to the common sense of his organization, or that requires a force of executives and clerks approximately as large as his production force, or a police force to make his foreman and operatives line up and use it.

Again, some of the systems have a way of assuming the prerogatives of the manager, and in a sense attempt to dictate to him how he is to manage, failing entirely to recognize that the manager is in control and responsible for results, and that the production department is, after all, only a tool, like the purchasing department, for the use of management in securing the result for which it alone is responsible. Another fact often observed in control systems is an inability

[1] See MANAGEMENT IN MANUFACTURING, September 1925, pp. 118-124, "The Modern Manufacturing Plant. American Type Founders Company Builds Largest Automatic Printing Press Factory in the World," by John F. Fallon.

to co-operate with other essential manufacturing departments, and the inability to function well when things go wrong, or a rapid increase or decrease in demand for finished product occurs, as governed by sales requirements, which are in turn affected by general business conditions.

Important Factors in Control

These, and other special conditions inherent to the manufacture of printing presses, decided W. M. Kelly, Division Manager of the company, to develop a system of control to meet his particular requirements. See. Fig. 1.

In the first place, as the word control implies, there should be a place where there can be centered all information as to what to make, how to make it and when to make it, also whether to make it at all or purchase it. These data must be simple, accurate, comprehensive, and instantly available for the manager's use and direction, and equally for others involved. Such information must be in a common language, understandable by all, to insure full co-operation of those it is supposed to guide and help.

It must show up requirements at once, and in advance of approaching shortages in purchase or manufacture, far enough ahead to permit correction without making every move a rush or emergency act. It must cover every single item of every sort entering into the final products. It must show how, and by whom, these items are being obtained, and the existence of orders and condition of deliveries.

It should show, in the case of parts to be made, the condition or quantity of raw or rough stock ahead. It should give such names, numbers, symbols and other facts as will enable those using the data to fully identify each item.

It should show the nature of material, pattern numbers or sizes, and be keyed so drawings, specifications and other facts can be instantly located, if further details are required. It should show locations of all stocks. It should be automatically self-checking to avoid errors and oversights.

Finally, it should be visible and place before the manager, or those charged with its operation, an instantaneous bird's-eye view of the entire production operation and all the real operating facts, present and future, as far ahead as considered necessary or desirable in a particular case, without the necessity of wading through a mass of cards, loose sheets or books. A *visible* system invites executive control by its availability. A buried or non-visible system invariably is left to subordinates who are not paid to think or control.

Preparatory Steps

All of the foregoing is easy to state, but was by no means certain of accomplishment when work was begun on the plan by Mr. Kelly and his executives.

As the first step, a careful study of a complete press of each type was made. A list by name, symbol, number, material and dimensions of each part was made, and identical parts were grouped. It was found that often in the different types of presses, the same part was used with a different name and number, often as many as 6 distinct names. It was found that at times deliveries were held up because the stock of a certain part for that press was out, while, as a matter of fact, an ample stock existed under another name and number, and there need have been no delay, had this fact been known.

The next step was to give to all different parts of every sort a separate individual number. This insured including all parts and prevented duplication or confusion. A study of each part was then made from its material or composition viewpoint, and a groupings was made under four headings or classes as follows:

Class A. Commercial or purchased parts of standard commercial design and dimensions, i.e., items obtained through purchase on the outside, in completed form ready for use, without any manufacturing operations within the plant. Examples of Class A materials are: Pins, screws, bolts, nuts, taper pins, cotter pins, oil cups, rotary air pumps, etc.

Class B. Purchased finished materials, or parts in part, or entirely, made to specifications furnished by the company to outside concerns or the vendor. Examples of Class B materials are: Springs, wooden feed boards, handles, thumb screws, special screws, special bolts, nuts, etc.

Class C. Purchased raw materials, or parts of commercial or special materials and dimensions, made to specifications furnished by the company to outside concerns, all of which require machining operations or manufacturing work of some sort within the plant.

Class D. This is Class C material after it is machined ready for assembly.

Material Sheets

Corresponding sheets[2] were then prepared, ruled and printed for the four classes. On these were listed all parts, under one or the other of the four classes, there being *no duplications.* Each item used appears once and only once on one or the other of these sheets. The Class D material classification sheet is ruled and printed in the same manner as the A, B, and C sheets, or purchase material sheets, although Class C items call for a certain amount of shop work for completion. Class D sheets include all items on which shop time or productive work must be done in the company's plant.

Fig. 2, which illustrates these sheets, is page 43 of the Class D group. Referring to this in detail, and reading the headings from left to right, we find that:

W. M. No., column one, gives the individual identification part number, known as "Worked Material" number. In selecting numbers various blanks have been provided, so that subsequent new designs of parts of like general name classification can be inserted and given numbers in the series.

---

[2] The design of these sheets is copyrighted by W. M. Kelly, and all rights to the system are reserved.

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PRODUCTION SCHEDULE OF W. M. PARTS—KELLY PRESS DIVISION—A. T. F. CO. DATE, January 1, 1925 **CLASS D**

W. M. No.	W. M. Assemb. No.	NAME OF PARTS Page 43	Symbol	Kind of Material	Material Size or Pattern No.	Stores Location	Quan. to Order	Days to Make	Period Schedule 10|10|24|24 Quan. Per Press K	J	S	X	M
		CRANKS											
13700		Reversing Crank		CI	K-126				1				
		CYLINDERS											
13800		Air Cylinder		CI	S-525						4		1
13801		do		do	K-152				4				
13850		Impression Cylinder		do	S-746						1		
13851		do		do	K-701				1				
13852		do		do	AJ-27					1			
13853		do		do	AJ-27-1					1			
		DISCS											
14000		Jogger Operating Disc		CI	S-826						1		
14005		Feed Operating Crank Disc		do	SF-236						1		
14015		Crank Disc		do	AJ-24					1			
14016		Lift Crank Disc		MS	1¾ dia.					1			
		DRUMS											
14305		Lowering Cable Drum—F. S.		CI	SX-43							1	
14306		do —G. S.		do	SX-44							1	
14315		Conveyor Frame Lift Table Drum		do	K-1547				2				2
14316		Delivery Cable Drum—F. S.		do	K-2235				1				
14317		do —G. S.		do	K-2236				1				
		ECCENTRICS											
15000		Vibrator Eccentric		CI	S-55						1		
15015		Impression Eccentric—F. S.		MS	2⅛ dia.				1				
15016		do —G. S.		do	do				1				
15017		Pile Feed Operating Eccentric		CI	K-1142				1				
		EYES											
15500		Truck Handle Eye		CRS	¼x1¼				4				2
		FINGERS											
16000		Stripper Finger		DC	S-215						8		10
16001		Shoofly Finger		Sh.St.							4		
16002		Tension Roll Arm Locating Finger		Sp.St.	.042x1⅜						3		
16003		Gripper Closing Finger		DF	S-579						1		8
16005		Double Shoofly Finger—F. S.		Sh.St.							1		
16006		do —G. S.		do							1		

JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4

FIG. 2 SAMPLE PRODUCTION SCHEDULE SHEET—CLASS D. (COPYRIGHTED)

W. M. Assemb. No., column two, is for the numbers used to identify such parts as are made up of several other parts assembled, i.e., sub-assemblies. Such numbers are composite and are made up by putting together the numbers indicating the separate individual parts.

Part Name, column three, gives the parts arranged under group names, i.e., "cranks" covers all cranks, but a particular crank known as a "reversing crank" has a part number 13700. Any other crank would be

FIG. 3 MASTER CONTROL BOARD AND OPERATOR

listed in this group with, of course, a separate and different number.

Symbol, column four, shows the cost department's manufacturing cost as a symbol number, or letters, for any particular part. This makes cost information available only to those properly acquainted with the key.

Material, column five, gives the materials from which the part is made: CI, cast iron; MS, machinery steel; CRS, cold rolled steel, etc.

Material Size or Pattern No., column six, in the case of a pattern, shows the pattern number. In the case of a purchased or shop-fabricated article it gives the dimensions, i.e., part 14016, "lift crank disc," shows 1¾ dia.

Stores Location, column seven, shows just where each particular item is carried in stock.

Quan. to Order, column eight, tells what number of any particular part to order for purchase or production when it comes time to enter a shop order, or to order from vendor.

Days to Make, column nine, shows the procurement time. In the case of purchased material, this indicates what time must be allowed to get in the required quantity. For parts to be made in the shop it shows the days required before the new stock will be available.

Period Schedule, column ten, indicates at the top what number of presses, extension deliveries and miscellaneous, i.e., replacement, parts are to be made per period. The sub-head under this column, *Quantity per Press,* shows the number of each part required per period, by one of each type of press, extension or spare for stock for customers' replacement orders. For example, one part 13700, reversing crank, is required for each K-type press per period. To complete 10 K-type presses per period, as shown by the period schedule, $10 \times 1 = 10$ would be the total number of such parts to manufacture, or take from stores per period.

The other columns headed by months are ruled in four sub-columns 1, 2, 3, 4. These correspond to the periods in each month.

Each period represents five full working days, or a total of 47 hr. of productive labor per week. Referring again to column ten, it will be seen that 10 type K's are called for during each period, or 2 per working day. For January, column eleven, this would mean 10 for 1st, 10 for 2nd, 10 for 3rd and 10 for 4th period, or a total of 40 type K presses for the month of January.

For annual production scheduling, the year is divided into three "grand periods" of four months each. That is, on this particular sheet, January, February, March, April is the first "grand period," and May, June, July, August is the second "grand period." During the first grand period the plant is working on a previously planned schedule, and the planning and scheduling section, which operates the production control, is laying out, or has completed the schedule for the second grand period, and in many items also the third grand period.

Running horizontally across the small squares under the month columns, and opposite each item, as shown at the left of the sheet, Fig. 2, are charted records over the squares. There are two of these charted blockings for each item, the upper, in each case being shaded, and the lower being stippled, in the cut. As actually employed, these lines are made with red and blue pencils, and are drawn in and extended every day at a stated time (10 o'clock A. M.) by the master control board operator. This will be explained later.

Master Control Board

The master control board, Fig. 3, is located in the planning and scheduling section of the production department, main office. It consists of four vertical frames holding beaver boards on which are mounted in convenient order by means of thumb tacks a full set of Class A, B, C, and D sheets. In other words, there is listed on the control board just described, every single part required to turn out the company's entire product.

In addition there is mounted on the master control board an Assembly Schedule Sheet which shows the predetermined production for each type of press by months, and periods, for an entire year, and the actual shipments by periods, as they are made.

This sheet shows at any time the relation of planned production to complete presses actually shipped. It does not show, however, spare part shipments, or press repairs, as these are handled separately, and are at most not large items.

(To be continued in the January 1926, issue.)

Material Handling Methods in the Edward G. Budd Plant

By W. A. GRAF

Engineer, Edward G. Budd Manufacturing Company

MASS production methods in the modern manufacturing plant, to be successful, must necessarily be carefully worked out with due consideration for the peculiarity of the product. Therefore there are many variations of these methods which produce the same satisfactory results. One of these variations calls for the flexibility of equipment and plant layout to take care of rapidly changing designs and improvements in construction which must be incorporated without an appreciable break in production schedules. The Edward G. Budd Manufacturing Company, shown in Fig. 1, the largest plant in the world engaged in the manufacture of all-steel open and closed bodies for automobiles and other stamped metal products, comes within this classification.

The plant has many customers among the leading American and foreign automobile manufacturers, whose factories turn out large quantities of cars per day and operate on a highly intensified production schedule. Concerns supplying them with products are under the necessity of making regular and prompt daily shipments. These requirements react fundamentally on shop processes and vitally affect departmental and machine layouts. Ample and flexible production capacity must always be immediately available to meet these manufacturing demands.

It will at once be clear to plant executives that material handling problems are greatly multiplied under such conditions. Mass production ordinarily indicates a plant layout along strictly straight-line methods, extensive use of conveyor systems of all kinds, and the elimination of a large amount of hand labor. But such elaborate systems are not feasible in cases like the present one.

The plant has seven railroad sidings with room for 81 cars. About 15,000 carloads of products are shipped annually. Sidings from the Chestnut Hill Branch of the Pennsylvania Railroad serve to bring in most of the steel and other materials, while those connecting with the Port Richmond Division of the Reading Railroad form the chief shipping points. Express car service is regularly provided at the plant.

Sheet steel is received in box cars which are shunted to the sidings adjacent to the steel storage department. Sheets are carefully inspected on both sides when they are removed from the car, by hand, and are stacked on low specially-designed trucks. The inspector stamps the best side of each sheet for use as the exposed surface when fabricating parts for automobile bodies.

These trucks are then wheeled out of the car onto a platform scale and finally into the adjacent steel storage department. Here overhead traveling cranes,

FIG. 1 EDWARD G. BUDD MANUFACTURING COMPANY, PHILADELPHIA PLANT

FIG. 2 TYPES OF TRACTORS, LIFT TRUCKS AND ELEVATING TRUCKS USED IN THE PLANT

equipped with specially designed grab buckets, take off the entire load at once and stack the sheets in high piles. Because of the large quantities used and the proximity of the plant to the steel mills, it has been possible to control inventories so that on the average the stock of steel turns over about 12 times a year. From storage the sheets are removed by cranes and grab buckets and delivered to the shearing operations. They are cut to sizes according to the requirements of the finished stamping. The sheared sheets are stacked either on trucks or on lift platforms consisting of I-beam sides with wood or steel tops. As the trucks are filled up they are taken away, individually or in trains, by means of tractors. The lift platforms, of course, are handled by electric lift trucks, of which the plant operates a great many varieties. See Fig. 2.

The succeeding operations are those which stamp and form the various body shapes out of the properly sheared sheets. The trucks already mentioned serve as storage reservoirs for the work that is processed, and similar trucks receive the stamped parts as they come off the presses. Tractors and electric lift trucks remove the loads of material as they are completed and deliver them to the assembling department.

The steel storage, shear and press departments are served by overhead cranes varying, in capacity, from 5 to 15 tons, and which are very essential in the handling of material. These cranes are also used largely to convey dies to and from the presses. Many of these dies are very large and heavy and could not be quickly handled by any other means. The cranes are also available to assist in moving machinery when new presses are brought in, old ones taken out, or when a rearrangement of equipment is necessary. A crane, principally to handle machinery in and out, is also located above a railroad siding convenient to the press shop.

The dies, of which there are many thousands on hand for the varying sizes and styles of body stampings required by the many different automobile manufacturers, are stored in departments adjacent to the press shops. See Fig. 3. The larger dies are stored on the floor. They are handled by overhead traveling cranes, as has been already described, and when necessary the dies are set down by one crane under another crane, operating at right angles to the first crane, which then picks up the die and delivers it to the proper press.

The smaller dies are stored on steel racks in the die storage department. They are likewise best handled quickly and conveniently by overhead crane equipment. Hence the storage racks have been equipped with tracks on which small cars made of steel rails can run. These cars span the aisles between rows of shelving and a system of trackage is provided to serve each shelf level. Overhead cranes pick up the dies in the press shop and unload them on the small cars in the aisle and at the shelf level where they belong when in storage. Sections of 2 in. pipe are put on the cars before the dies are lowered down, and these pipes serve as rollers on

FIG. 3 A CORNER OF THE DIE STORAGE DEPARTMENT

which the dies are shoved back into their proper locations on the shelves. The rollers in each case remain underneath the dies so that when they are to be taken out again it is necessary merely to bring the steel cars into position and pull the dies forward onto them within reach of the crane.

After parts are stamped and formed they are either welded or riveted together, as the specifications call for, in sub-assemblies, group assemblies, and finally, in most cases, into the completed body. The parts are delivered to the welding department by means of trucks of various kinds, depending upon the size and shape of the parts. Many of these trucks are handled by tractors. Small parts are delivered in steel box trucks. Plant layout follows largely a vertical system of manufacturing and hence the parts are delivered in the majority of cases from press departments on the first floor, successively to upper floor levels for consecutive operation, and finally to the top floor where complete bodies are assembled. Large electric elevators, of which the plant has 10, of adequate capacity, carry the trucks up and down as necessary.

FIG. 4 ALL-STEEL BODY ASSEMBLY DEPARTMENT EQUIPPED WITH CONTINUOUS CHAIN CONVEYORS

In the departments where welding and riveting of small parts are carried on, the unfinished parts are stored on the delivery trucks at each machine until processed. The operations are standardized and are made successive for each type of body, and consequently may be handled on the ordinary mass production basis. Thus, between machines, steel chutes have been provided, and as an operator completes each piece he lays it at the top end of one of these chutes and it slides by gravity down within reach of the man who performs the next operation on it.

In the assembling of the outer and inner panels of such parts as roadster decks, the two pieces are delivered to the welders on gravity roller conveyors, the outsides coming along on the upper level and the insides on another level immediately below this. The assembled parts are put back again on the upper level of the conveyor which carries them down to the next operation.

In the handling of finished all-steel doors during final operations a series of hooks suspended by means of trolleys from an endless track, rectangular in general arrangement, is used to hold the doors and to move them gradually around from the loading point to the inspection.

After the final assembly of all-steel bodies in the upper stories of the plant, the finishing operations are performed while the bodies move forward on power conveyors. See Fig. 4. Parts arrive at the department in minor sub-assemblies and are fitted together and undergo certain of the welding operations in the final assembly jigs. Then they are delivered to the power conveyor and as they travel down the room the various final operations are performed. At the discharge end of the conveyor systems, which are of the continuous chain type, there are located overhead carrying systems. Trolleys running on these overhead tracks carry a group of special hooks designed to pick up the particular types of bodies under manufacture. Each car is delivered to an inspection jig where it is accurately tested for dimensions and contour and carefully gone over to see that all joints and surfaces are perfect. The inspected bodies are then lifted over to the horizontal roller conveyor and moved down the room for delivery to the shipping department.

Here the variation in sizes and styles prevents the application of a universal conveyor system. Moreover, the drop is almost vertical from the upper stories to the first. Hence, the most suitable system of handling to employ is a chute. A wire cable running over a power-operated sheave is attached to each body by means of a heavy hook and the body is lowered by hand control to the shipping platform. See Fig. 5. Here it is pushed off onto a turntable in an oil spray booth where it is coated both inside and out to keep it from rusting in transit. It is then run on a small handtruck and wheeled into a box car for shipment. Fig. 6 shows a body leaving the spray booth and being placed on a truck.

Most companies purchase bodies which are completely assembled before leaving the plant. Some, however, do their own assembling work and have shipments made in the form of assembled units. Aside from final assembling operations these parts go through the same handling procedure as parts for bodies completed at the plant. All products shipped are carefully packed

with wood framework and excelsior pads around them to prevent damage in transit.

The system of material handling must operate so rapidly and promptly that it is tied in closely with the work of the planning and production department. This department is organized into two main groups, operating and statistical, whose functions, in general, are explained by their names. Connected with the

FIG. 5 UPPER END OF BODY CHUTE TO SHIPPING PLATFORM
All-steel body ready for lowering four stories.

statistical group are the press checkers and assembly checkers. These men are located in the shop and are held responsible for keeping constant tabs on production at all times during the day. They work in close co-ordination with the foremen of the various departments and with the trucking supervisors in each manufacturing aisle.

The production checkers know exactly what kind and how much of each product is scheduled for every individual day. Tickets are hung up on each machine showing what its output must be during the course of the shift. A definite number of each kind of parts to be processed must therefore arrive in the department during the day and be fabricated. The production checker follows up the receipt of this material and takes immediate steps to have it forthcoming if any delay arises. He also works in with the foreman to see that the correct output of each machine is maintained, so that there need be no last hour rush to get the scheduled quantity out on time. As the parts are completed he watches to see that they are promptly delivered to the next succeeding department, and he reports any delay in removal to the trucking supervisor, who then takes care of it immediately. Very careful co-ordination in this work is absolutely required, as otherwise an entire division might be tied up and prevented from getting out its daily production.

A central storeroom has been established to serve the entire plant with material and supplies of all kinds except sheet steel, which is handled in the manner previously described. Formerly there was a storeroom in each department, but this method of operation was neither satisfactory nor economical. The central storeroom has been a decided improvement.

All supplies are requisitioned as needed by the various departments and material is delivered at once by messenger. Telephoned orders are immediately filled and delivered to the department ordering within a few minutes. The purchasing department controls and superintends the storeroom activities. Some of the materials going into this storeroom are delivered by the source of supply, but many items are obtained locally and come in by the company's trucks from the manufacturers. Delivery of supplies from the central storeroom to the manufacturing departments is made by means of shop trucks of various kinds, or on platforms handled by electric lift trucks.

The company operates six auto trucks. When incoming materials or outgoing products are not to be handled by the regular outside established systems, these trucks are called upon to perform the work. A special form is filled out for each case, stating where the truck will have to go, what kind of material is to be handled, its weight, and where it is to be delivered. Telephone and messenger communications give prompt contact with the supervisor of transportation, who has charge of all outside trucking. He sorts the slips thus made out and arranges the best routes for each truck

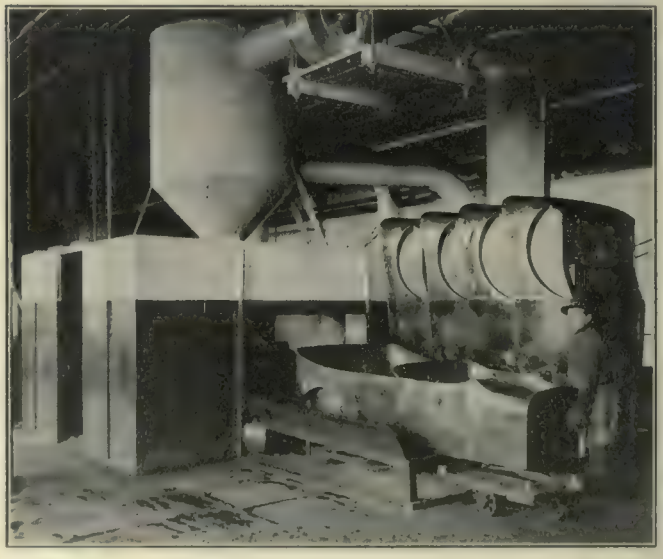

FIG. 6 ALL-STEEL BODY BEING PLACED ON TRUCK FOR DELIVERY TO FREIGHT CAR

to cover. On account of the wide variation in weights and sizes of items handled, it is not possible to assign any one locality to a certain truck, nor to avoid overlapping of routes on many occasions.

About 3500 hand and electric trucks of 17 varieties are employed in the handling of the product during the various stages of fabrication.

The Financial and Industrial Investigation

Its Purposes and Problems

By ARTHUR ANDERSEN

Arthur Andersen & Co.

THE success of a business depends upon the ability of its management to take action based upon sound decisions. This is most true from a long-time viewpoint, as over short periods it is possible for an element of luck to enter in which results in earnings independent of the qualities of management.

Sound decisions can be reached only as a combination of good judgment with a knowledge of the *true and complete facts* of any given situation. In business, as in all forms of human endeavor, it is the securing of facts which proves most difficult. In modern business, with its marvelous size and complexity of individual units, this difficulty is far more pronounced than it was some decades ago, when business was done in very much smaller individual units.

When one man runs a business small enough to be run effectively by one man, he may know it so intimately and in such detail that no essential facts remain long concealed. When this business grows in size, acquiring greater operating facilities and covering greater sales territory, the one man will no longer be able to exercise his former intimate control. Instead, there is a passing on of responsibility to others and a more or less definite assignment of functions. The one-man control will necessarily be replaced by the control through organization. Unfortunately an organization is composed of individuals, and only rarely can the efforts and viewpoints of several individuals be so well co-ordinated that they even approach the co-ordination inherent in a single person.

Modern Aids to Management

The result, therefore, is liable to be one of overemphasis in some points, gaps of information or ability in others, a general lack of vision for the business as a whole. Even the chief executive may be biased by experience, training or inclination, so that his viewpoint is narrowed or distorted. It is true that management is sometimes aware of its own shortcomings. It realizes a possible lack of ability in the technique of business, but seldom admits inability in matters of decision because it overweights the factor of judgment and underestimates the danger of insufficient or distorted knowledge of facts.

Because management realizes the possible limitations in technique of its internal organization, and because its problems are becoming every day more complex, it has in the past few decades resorted to many special technical services as an aid to its own functioning. In matters of incorporation, of reorganization, of patents, of contracts, or of technical liability it has long had resource to legal talent and now few boards or large corporations fail to include their legal counsel in the directorate. In matters of finance, of reorganization, of recapitalization, its bankers are by necessity and custom called upon in an advisory capacity. In the preparation of correct financial statements, and in matters involving correct accounting procedures and methods, special technical ability is called for from the ranks of accountants. In matters of property valuations or of perpetual plant and equipment records the appraisers contribute their quota of skill.

Some of these services are primarily concerned with the determining of salient facts and some are concerned with the supplying of judgment along certain special lines. Yet it remains for the management itself to co-ordinate all of these specialized viewpoints so that they will bear upon the single problem of the best interests of the business as a whole. Aside from the management, the only interests who are directly concerned with such a viewpoint, are those financially involved in the business—stockholders and bankers. But often the stockholders are the management, or else place their trust in the management, rousing to action only in the event of unsatisfactory earnings. So it may broadly be said that bankers as a whole (and this is increasingly true) incline to view a business in its broader aspects and to be concerned with the same problems that concern the management. The banker often represents the holders of senior securities in much the same sense that the management represents the holders of junior securities.

Because bankers see many businesses, because they cannot of themselves know the intimate details of a given business, and because of their responsibility in the matter of securities issued, they have gone a step ahead of management in the use of a recently developed technical aid to business. This aid is known as the financial and industrial investigation. One of its principal uses has been to lay before both bankers and management a broad collection of salient facts on any particular business—so arranging these facts that they represent an analysis of the policies which have regu-

lated that business, thereby judging the effectiveness of management.

The banker uses this investigation as a preliminary to financing. It reveals the true facts of past operations from a comprehensive viewpoint and gives some basis for forecasting the future of the business over the life of the security issue. Even in this usage the investigation becomes an aid to management, if it convinces the banker of the soundness and necessity of the proposed financing.

Definition of Financial and Industrial Investigation

This form of investigation may be described as being a study and analysis of the three elements of business, in their relationship and co-ordination one with the other. These three elements are:

1. The equipment of business, which includes buildings, equipment, machinery, personnel and product.
2. The mechanism for controlling and directing the use of this equipment, which may be termed management.
3. The conditions under which this equipment must be used by management in order to result in earnings. These conditions include competition, markets, location, demand, transportation, general prosperity or depression, monopoly, etc.

Such a definition is extremely broad, and a simpler expression is to state that the investigation is an effort to determine all of the salient business facts of a given situation, to analyze these facts and to present conclusions which will be of a constructive nature.

If the investigation is made for purposes of internal guidance—at the request of the company officials—it may be of a more detailed character than if it is made at the instigation of bankers and in connection with financing, but fundamentally the points considered and the data used will be much the same in either case.

A similarity to this form of analysis is found in the "commercial research" departments now maintained by a number of the larger companies. Such departments, however, usually carry on work which is only a portion of that covered by the investigation, since it is seldom their function to analyze the internal financial conditions of the company or in any way to be concerned with the specific financial structure or the characteristics of outside financing. They do, however, go rather deeply into the analysis of sales, the various economic factors of the industry and the relative position and course of the company in the industry. There is no need to go any further into this question of commercial research departments than to point out the basic fact that management thereby admits the necessity for information related to economic trends and positions, and also to emphasize the further fact that economic principles must be kept clearly in mind during any financial and industrial investigation.

Really two fundamentals may be laid down in connection with these investigations, economic experience and common sense—it is hard to say which is the more important. Of course, the heading of experience must be amplified to include knowledge, a knowledge of economics, of organization, of accounting, of engineering, of manufacturing, of men, of businesses in general and of the qualities of management. And the heading of common sense must be understood to include a large portion of vision or imagination.

Types and Sources of Information

As has been stated, the investigation is based first of all upon the collection of correct basic data. This may be drawn from many sources, but probably the greatest bulk of it comes from the past records of the company. It must not be inferred that this class of data is the most important or most significant, but at least it is tangible and in it should exist not the least trace of inaccuracy or uncertainty.

For example, it is often necessary that the investigation make use of unit figures on sales, etc. It may well be the case that such unit figures are different from the sales values appearing in the audited profit and loss statement. This is due to several reasons. Either they may not include returns and allowances, or they *may* include consigned goods, or they may contain clerical errors, or they may not be tabulated for exactly the same period as the audit values, or the units classification of the sales department may differ from the value classification of the accounting department.

Careful analysis must be made even of audited statements which may be available, in order to insure an exact correlation of the statistics as to quantities or tonnage with the audited dollar values and to make certain that the accounting policies followed have been consistent over the period of years considered and have resulted in statements of earnings and financial condition that are correct.

Another class of information is that gathered relative to conditions in the given industry, possibly involving an analysis of the trend of prices, costs, production, sales, labor rates, investment, etc., over a period of years. This is secured from government files and publications, from trade associations and trade publications and from published results of industrial research.

Features which must be studied and judged during the course of the investigation involve such questions as to whether the company is properly located with respect to its supply of labor and raw material; whether it is favorably situated with respect to its markets for finished product; whether the buildings are well or ill adapted to the particular type of manufacturing; or whether its equipment and its methods of processing are up-to-date, economical and practical.

Points of Analysis

One of the principal subjects of study is the personnel of the company and the arrangement of this personnel to form an organization. First, the organization plan must be studied, then each man in any position of importance must be studied in the light of his effectiveness in the particular function. These functional standards are naturally flexible and somewhat indefinite, being set as the result of experience

and by the operating results shown.

This study of personnel is only one of the items which form an important part in this class of business analysis. There is also the studying of balance sheets and earnings statements from the viewpoint of the business rather than from that of accounting technique. The total of the inventories is less important than the relationship between inventory and sales, or inventory and receivables, or inventory and fixed assets. The current assets are important by reason of their make-up rather than their value; or by reason of their relationship to current liabilities or to bank loans. The ratio of contributive capital to loaned capital is important. The make-up of net worth is far more vital than its amount. The trend of earnings is more significant even than their relation to net worth, which is in turn more important than their actual amount. Earnings in certain years, such as 1921 and 1922, are extremely significant, as are also the make-up of debits to surplus in these same years.

In the analysis, the geographical distribution of sales may hold a large significance as bearing on the future trend of total sales, while the distribution by principal customers may indicate a potentially dangerous condition. The position enjoyed by the company in its own field of industry and the position of the type of business with reference to industry as a whole are also considered.

Then there is the study of many special bits of information which do not ordinarily appear in any financial statement, such as the distribution of stock holdings, make-up of the board of directors (with even the personnel analysis of these directors), variations in stock control or voting trusts over a period of years, analysis of principal executives as to age, length of service, salaries, stock interest, prior working experience, etc. These matters are usually of importance only where the matter of refinancing is involved, but here they may attain a vital importance. The financing may practically hinge upon the question of extent of stock interest by the president or general manager, and a study of salary range and scale may reveal a primary indication of poor management.

Classification of Investigations

That the investigation may be made for two distinct purposes has already been noted. The investigation made at the request of the management may be classed as "internal" and is usually called for because of some specifically disturbing condition. The investigation made primarily for bankers may be classed as "external" and is called for either as a preliminary to financing or because of unsatisfactory operating results subsequent to financing.

The internal investigation is usually of a special and detailed nature while the external is broader in scope and purpose, though exhibiting many of the methods and much of the data which is demanded by the former.

The internal investigation is usually made for the direct and immediate purpose of *assisting* the management, while the external investigation often has as its primary reason the *testing* of management. The internal is called for because certain things are known to be, or suspected of being faulty. The external is made to ascertain whether the policies of management are correct in principle and application and whether the future is likely to be such as to result in the continuance of earnings.

Conditions Leading to Internal Investigation

The conditions which lead to internal investigation may be many and varied. For example, the management may note a decrease in sales, which the sales department cannot satisfactorily explain, or it may be that profits are decreasing even though sales are being maintained in normal volume, or inventories may be increasing out of normal proportion, or some one department may be showing unsatisfactory production or increasing costs, or monthly statements may be slow in coming in, or there may appear to be too large a clerical force for the volume of business, or perhaps there is a condition of confusion in credits, collections, or accounts receivable records. In fact, any one or several functions of the business may be showing signs of weakness.

Thus the internal investigation partakes of the nature of diagnosis and usually follows a failure on the part of management to find a remedy, for usually the business has been trying all sorts of home-grown remedies for the condition before it will admit its inability to effect a cure and feels impelled to call for an outside diagnosis and treatment.

It is evident from this that the internal investigation is primarily a diagnosis which is intended to be followed by corrective action. But often it is difficult to make the management see the necessity for investigation before the corrective work is commenced. The investigation is, however, very distinct from the corrective action, which may be termed an "installation." For example, a company may request a "cost system," expecting to have put into effect a completely cut and dried plan, with a few new forms, and to secure in a few weeks' time accurate costs on all products. As a matter of fact there is seldom any such thing as a cost "system." There are certain basic theories for securing costs, but these are different from the actual clerical methods necessary to securing costs, and these methods are usually different in every business, due to the modifying factors of operating methods, organization, size, personnel, present records, etc., which are the individual part of a particular business.

Therefore the investigation must be made first. By it are determined the actual present conditions existing in that particular business. Thereby it is possible to lay a finger on the faulty or incomplete points. And with the investigation are combined the theory, economics, and long experience with similar problems necessary to produce a sound program of correction. This corrective program is usually not worked out in detail as a part of the investigation, but all of the broad, directive principles will be there. The reasons for not going into full detail are three in number. First of all management may not wish to go ahead

with the complete constructive program, so that the inclusion of details would merely represent wasted time, effort and expense. Secondly, after the corrective work is begun there may frequently be brought to light some further modifying conditions which would tend to change the actual details of the plan. And finally, the inclusion of too much detail tends to obscure the basic theory and plan of the corrective program.

Conditions Leading to External Investigation

Usually the external investigation is made at the request of the management, for the financial investigation has by no means as yet attained the recognition given to the audit. Few business men would ever think of asking for permanent financing unless it was possible to carry to the banker an audited balance sheet. Yet practically no business man ever thinks of carrying to the banker the report of a financial investigation. The banker, however, is beginning to realize that on loans covering from 10 to 20 years he needs to know more about the company than can be obtained from its audited statements.

This is truer of the larger banking institutions, of course, than for the smaller ones, because greater values and greater responsibilities are involved. It is because of these responsibilities that many of the larger banks are beginning to stipulate that the company desiring financing shall provide both completely audited figures and a complete financial and industrial investigation report.

Difficulties of External Investigation

It may happen that because of the findings of the investigation, the banker decides to turn down the security issue. Then the company must pay for the work which has made its financing impossible and for a report in which the management itself may be rather severely criticized. If it is of a type subject to criticism it is very possibly narrow visioned and unprogressive enough to fail to grasp the justness of the criticism or to make any of the constructive changes recommended.

Even under the best conditions it is difficult for the company management to see any necessity for the investigation, since it feels that an audited statement should furnish all of the information vital to the banker.

This is not a universal attitude and occasionally a business contemplating financing calls for such an investigation, using its findings either as a basis for corrective work preliminary to financing or as a basis for better terms of financing. In this way an internal benefit accrues from an investigation which was made primarily for external purposes.

It sometimes happens also that the bankers stipulate that certain of the investigative recommendations be carried out by the company as a prerequisite to financing, so that a purely involuntary benefit is obtained by the company, which may or may not agree with the soundness of these recommendations.

The confidence placed by the bankers in the results of the investigation is not, as a rule, shared by the company officials. The banker has learned by several experiences that the investigative findings, conclusions and recommendations are sound. But the company has had no such experience and every statement is subject to the closest scrutiny, comment, study, and demand for proof.

It is this "show me" attitude which makes it difficult for the investigator. By reason of his experience he may know that certain things are wrong, yet he must first show that certain conditions exist, must show what they mean and the dangers they may lead to. He is in the position of having to prove not only the work, but all of the theories back of it. And if the report contains even a minor misstatement—due possibly to receiving incorrect information from some official, or to overlooking some item—it may be seized upon as an evidence that everything in the report is unreliable. The report has to be practically perfect. Everything stated must be correct and provable, it must be complete, yet without anything unnecessary or irrelevant.

Future Uses

It is evident that the financial and industrial investigation makes use of all of the data which may result from other specialized forms of service to management, correlating this material to give a complete analysis of the business as a whole. In view of the increasing tendency toward combinations and mergers, aided by greater public participation in offerings of industrial securities, such an analysis is of increasing importance to the investment banker. It enables him to pass upon the worth of a security issue with greater assurance in discharging his moral obligation to investors.

Similarly, the formation of these large operating units entails new management obligations. The larger units are less subject to special or local conditions, but more influenced by basic economic principles and by the large trends of industry. Management problems thus are of broader concept. At the same time, the details of operation are tremendously magnified and the possession of true and complete knowledge of the business requires uniformity and completeness of records and systems.

Management will find in the investigation one of its most comprehensive aids to judgment and control, just as the banker will find it the best means of marshalling the essential business facts.

The work done along these lines today is far in advance of the tentative analysis, largely based on accounting, of 10 years ago. The analytical investigations made 10 years hence will make present-day efforts appear feeble and tentative. But management itself is in much the same state, for each day sees management becoming more scientific and more highly organized as the increasing size of industrial units brings new problems of administration. Competition increases as all manufacturing and merchandising methods become more nearly standardized. Profit margins are decreasing. Success is the reward of management rather than the result of chance in invention, discovery, or exploitation of natural resources.

Buick Saves $100 Per Car Exported

A Trial Shipment of Unboxed Automobiles to Antwerp Proves to be a Complete Success

By GEORGE F. BAUER

Manager, Foreign Department, National Automobile Chamber of Commerce

READERS of MANAGEMENT AND ADMINISTRATION will recall that the author, in a previous article published several months ago, demonstrated the savings which would result from doing away with the boxing of automobiles for shipment abroad.[1] As a result of investigating these possibilities the General Motors Export Company made a trial shipment of cars to Antwerp during the month of October and the experiment was so thoroughly successful that before long the export box promises to be a thing of the past. One progressive American steamship company has been awake to the opportunity for increased business through co-operation with manufacturers to cut out unnecessary shipping costs, and stimulate foreign sales by consequent lowering of export prices. The rest are sure to see the wisdom of this course, which is based on the simple principle of adapting the ship to the cargo.

Any reduction obtained in the price of a product for export almost immediately results in a greater volume of business. This is true because the article becomes available to an additional group of buyers whose purchasing power previously was not sufficient to buy the article, but who can afford it at the reduced price. This economic principle holds good particularly with automobiles, and a price reduction based on a saving of $100 to the manufacturer has a most remarkable effect in increasing volume of business in countries abroad.

To effect a reduction in the price of the automobile to the foreign customer, it is necessary first of all to see that the vehicle is transported to him with the minimum amount of expense from the time of departure from the factory until arrival in the showroom of the foreign dealer. The boxing of an automobile destined for the foreign market has up to now represented a considerable item in this expense. This condition was due primarily to developments during the war when cargo was abundant but cargo space very scarce. It was at that time very necessary to pack commodities knocked down and in such a way that as little space as possible would be taken up in the ship's hold. As a result, the conviction grew up, and has continued to exist, that automobiles must be boxed when destined for foreign countries.

At the culmination of the war there had been developed a large merchant marine and in proportion too little cargo was available for the space offered. There accordingly arose a tendency to adapt the ship to the

[1] See MANAGEMENT IN MANUFACTURING, March 1925, pp. 241-244, "Getting Rid of the Export Box," by George F. Bauer.

FIG. 1 RAILROAD FREIGHT TERMINAL AT CHARLESTON, SHOWING THE VAST EXTENT OF WATERFRONT WAREHOUSES AND FACILITIES FOR TRANSFERRING SHIPMENTS FROM CARS TO VESSELS

FIG. 2 HOISTING A CAR ON THE SHIP

cargo, and in that way to effect savings in the actual transmittal of goods and bring down costs to foreign customers.

One of the men first to appreciate the necessity for such a step was R. S. MacElwee, Commissioner of the Port of Charleston. Due to his efforts the Carolina Line which operates steamers from Charleston to Europe and the Far East, has adapted certain of its ships for the transfer of automobiles from the United States to foreign destinations, with promise of large economies to manufacturers.

Export Costs

All automotive exporters know that the cost of boxing for export is very heavy; also that transportation, customs house and other charges and dues are pyramided upon the original cost and weight of the shipping box.

Translated into foreign currencies, many of which have depreciated, the saving possible through shipment of automobiles on their own wheels, unboxed, makes possible very decided price cuts to the ultimate consumer, and therefore provides for a wider market and greater competitive ability for those automobile manufacturers who take advantage of this method of exporting their products.

FIG. 3 ROPE SLING DEVICE USED BY WARD LINE

Under the system inaugurated by the Carolina Company to make it possible to eliminate the export box, automobiles may be loaded into the usual type of box freight cars at the factory. The same loading operations are employed as have been found effective for domestic shipment. In fact, there is no difference between the two procedures from the time the automobiles are loaded into the freight cars at the factory until their arrival in Charleston.

The freight cars are brought alongside of the warehouses at the terminal. A distinct advantage exists in the fact that the automobiles are not re-handled in lighters and thereby kept in the open, subject to damage from rain or snow. They are run out of the freight car and stored in the warehouse, which is located close to the wharf, until the time comes to load them on the vessels. Ample storing facilities are available at Charleston and the practice prevails of allowing 15 days free time on all shipments.

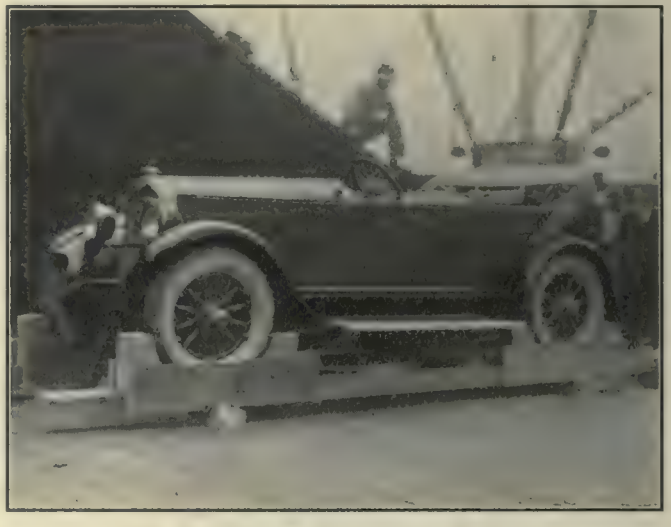

FIG. 4 RACK TO HOLD CARS IN PLACE

Fig. 1 shows the large port terminal at Charleston, where railway cars are brought alongside of the storage sheds by means of spurs from the main line.

Besides facilities for direct handling of shipments, Charleston has also an advantage in the preferential rate charged by the railways on shipments destined to that seaport as compared with those going to New York. An automobile made in Flint and shipped unboxed to New York is subject to a rate of $1.37 per 100 lb., whereas one destined to Charleston is carried at the lower rate of $1.31 per 100 lb. On a Buick touring car weighing 3325 lb. this means a saving of about $2.

After the automobiles are unloaded from the box cars and before they are moved into the warehouses, inspection is made to see if they have been drained of gasoline and oil at the factory, and if the various tank caps have been taken off and attached by wire or cord to the car. This precaution is taken in order to assure complete absence of gasoline and oil fumes.

The windshield is removed and secured in the tonneau on a light frame attached to the robe rack. The top is also removed and reversed. In this way, space requirements are reduced to a minimum, but the cars move on their own wheels and are unboxed.

Arrangements can also be made to have local agents supervise the unloading from freight cars, carry out the inspection, and take care of any small troubles such as flat tires, that may have developed during transit from the factory to Charleston.

When the steamer is ready to load, the automobiles are pushed from the warehouse to the wharf at a point where they are to be picked up by the ship's tackle. See Fig. 2. The brakes are set and the cars are picked up in a rig consisting of a pair of spreaders and four specially constructed grapples, one for each wheel of the car. They are then deposited in the hold. In the

FIG. 5 RUNNING CAR ON RACK IN THE HOLD

near future, rope slings, which have been used elsewhere with success, will be employed and the grapples will be reserved for large busses and trucks. See Fig. 3.

Racks specially constructed for the purpose of holding the cars have previously been placed in the ship (see Fig. 4) and the automobiles are run into proper position on them. See Fig. 5. The racks with automobiles are then jacked into position in the wings and chuck blocks are set on sides of wheels in order to keep the automobiles rigid. As an additional precaution, the axles are tied to the racks by means of rope.

Utilization of Space

To utilize space to greatest advantage the practice is to stack lumber, which is part of the regular cargo, on the floor of the hold to such a height that the racks and automobiles will fit in snugly without any excessive loss of overhead space. The racks are tommed down on this lumber by uprights, wedging them so that they cannot move. The automobiles are then ready to be covered with awning canvas for protection in case inclement weather is encountered during the trip.

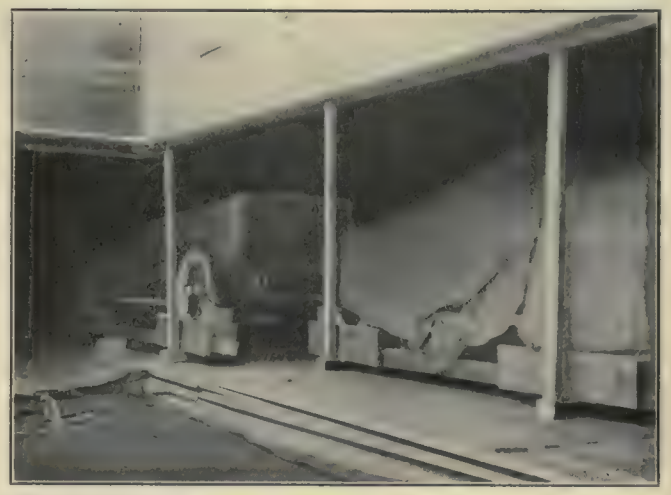

FIG. 6 STRUTS PROVIDE RIGIDITY AND CANVAS PROTECTS CAR

Fig. 6 shows them in final position for the sea voyage.

The initial shipment made in this manner as a trial consisted of nine Buick automobiles of the standard touring type. Arrangements were made on behalf of the General Motors Export Company by William Harvey, Manager of Operations. Actual supervision was exercised by Captain H. R. O. Johnston who has had considerable experience in handling unboxed automobiles in his previous connection with the Ward Line, which transports large quantities of cars in this manner from New York to Cuba.

Trial Shipment to Antwerp

The trial shipment was sent to Antwerp. Even though a very rough sea was encountered during the voyage the automobiles arrived in excellent condition and to the entire satisfaction of consignees. Unloading from steamer was also effected without any mishap, for Antwerp has superior facilities as a shipping center.

The elimination of the box is certain to have far reaching effects. The slowing up of shipments is avoided, which always develops in the factory when special arrangements have to be made for boxing, and consequent deviations from straight-line procedure followed in domestic trade are introduced. The need of breaking open the box and re-assembling the car at considerable expense at the other end is also done away with.

If the car is destined for a country that applies an ad valorem duty on the c i f value, including cost of boxing, as is done in France, the effect of eliminating the box is of even greater importance. In that event the duty of 45 per cent on the boxing charge of $65 would be $29.25. If this duty is added to the actual cost of the box it can readily be seen how considerable a sum becomes involved. Furthermore, there are internal taxes which are applied on the duty-paid value of the automobile. The total savings are over $100 on a medium-priced car when boxing is done away with in transporting automobiles to foreign countries.

In view of the success of the trial shipment and the definite demonstration of economies, the General Motors Export Company plans to follow the method

up by similar foreign shipments of automobiles on a larger scale. Reo cars are also being sent abroad in this manner and other companies contemplate following suit in the near future.

The stimulus that this trend will have on the entire automotive export trade is best appreciated by reviewing a similar development in the domestic industry. The real boost in automotive transportation resulted directly from bringing prices down within reach of a large number of potential users. A probable reduction in prices of American cars abroad brought about by eliminating the export box, presages a foreign demand equally as potent as that stimulated under similar conditions in the United States.

Getting Rid of Idle Machine Hours

By E. H. FISH

MACHINES should be kept busy for the full 144 hours of the six-day week if they are to turn out maximum production. But in most places they are under power for no longer than 48 hours, out of which their period of useful work averages only about 24 hours. The workman running such a machine may not be idle, but the machine itself is while he is setting up work or hunting equipment.

Conditions Under Which Machine Shop Work Is Usually Done

Highly specialized shops can afford to buy quick acting fixtures to clamp work in place and keep machines in operation most of the time. Other plants have machines arranged in groups for successive operations on parts, and thus keep equipment in continuous production. But the great bulk of machine work is done under conditions where each new job means a hunt for the right rigging—mandrels, dogs, planer chucks, straps, pins, and a multitude of similar items.

In rush times equipment is kept busy by running a second and even a third shift, although the third shift does not always pay from a financial standpoint. But even with seemingly ample auxiliary equipment in the way of rigging, and with a double shift on the job, how can we make sure to get the maximum returns out of a given investment in machinery?

There are two effective ways. One is to study the setting up of the jobs as carefully as correct speeds and feeds have been studied. The other is to operate two shifts of men at hours which satisfy both groups.

Work Set-Ups

In almost any shop an examination of work set-ups will show opportunities to save money by a little additional investment in rigging. The time wasted in changing from one job to another on a machine such as an engine lathe is great. It probably involves something like this: Get a suitable dog, either from the tool room or from the pile of scrap under the bench. Find that the screw has been jammed and try to straighten it. Break it off and then look for another dog. Pick up one too large and hunt in vain for a copper or brass shim to put under the screw. Try a hex nut, but discover that it was intended to be used to fit the thread on the end of the piece, too, and that consequently another nut has to be found. Shove up the tail stock, which never comes just right. Move it back an inch or two and run the spindle out so that the compound rest can be swung around; and so on through an almost endless list of operations equally unnecessary and wasteful.

The planer is worse yet. The right rig is never around. The big angle is over at the radial drill on a job that will last a week. The bolt heads have been cracked off, or they turn around in the slot because they were made to be used on the little planer. The surface gage has lost its adjustment and the work has to be run back and forth under the tool to line it up.

The solutions are easy. Buy or make rigging. Get dogs, and have someone see that they are usable, or else in the scrap heap, and that the scrap heap is a mile or more from the shop. Why a superintendent will pay thousands of dollars for a machine and let it stand idle half of the time for lack of twenty-five dollars' worth of rig, no one knows.

The Double Shift

The double shift is a question of finding hours which are acceptable to the men. These hours depend not only on the men and their wives, but on housing and transportation. If the first shift goes on at 7 A. M. and quits at 3.30 P. M. and the second goes on from then until midnight, each with a half hour for lunch, there will be trouble unless there are trolleys or busses for getting the men to and from the plant at these particular hours. The late shift will be hard to fill because those who work in it are cut out of all ordinary entertainment. The men can hardly see a movie and then get around to the shop so early in the afternoon. Dances are out of the question. This shift consequently must be recruited from among men whose recreations are those which can be indulged in outside of the usual evening hours. Men who want to take on a side line like selling aluminum ware, or brushes, will like the idea. Men who are "paying for dead horses" will be glad of the incentive to save because there is no chance to spend. But generally there are not enough such men to make up a large night shift, and unless only one shop in a community is running two shifts it cannot usually be done.

An Unfailing Way to Reduce the Costs of Steam

By HUBERT E. COLLINS

Mechanical Engineer

AT one time during the World War, the United States imposed some necessary restrictions on the use of fuel and was threatening more at the time the Armistice lifted the ban. One proposal was that all fuel-using plants be rated according to their efficiency. With this prospect facing them, many plants invested in the necessary equipment for records to establish efficiency. Some plants had the instruments purchased and delivered, but not installed when the threatened class rating ban was lifted. The instruments were stored away and have been gathering dust ever since.

This illustrates the attitude of many industrial managers toward the expense of record taking instruments in the power plant.

Thirty years ago engineers stressed the importance of the engine room over the boiler room. The design of new prime movers took most of the thought, for the improvements came fast. Single cylinder, compounds, high and low speeds, horizontal and vertical, high pressure and low pressure, condensing, all had their advocates, designers and manufacturers. Like the waving of the red flag in the bull ring to attract the attention of the animal from the matador, this array of changing engine design took the attention from the boiler room. The gaze still was focussed there for a few more years as turbine units acted the part of the "stage villain" trying to take away the heritage of the reciprocating engine, and the unaflow attempted the part of the "rescuing hero." Both these lost their full realization while winning a permanent part on the "prime mover stage" with the others.

Eighty per cent of industrial power plants lack records on which to base comparisons of performance and costs. The item "Cost of power," when used in figuring manufacturing costs, too often includes improper charges. Yet all the factors entering into power plant operation can be measured; instruments are available to produce the records. From such records accurate costs can be determined and deficiencies in operation corrected before they amount to serious losses.

Growing Importance of the Boiler Room

During the period of activity on this part of the stage, the "red flag" effect was lost and the public gaze found the boiler room was larger than the prime mover in real importance. In fact, the boiler room has the larger area of attention on a combined field of "power plant design."

While the boiler room has assumed its rightful position in importance and is accorded its due, yet the majority of owners of industrial plants have been slow to equip them with devices to check their operation and detail the costs. In this respect the boiler room is still where it was thirty years ago. It is this class of owner who purchased instruments for his boiler room while under threat, but relegated them to shelf and closet when the danger was past. He felt that power plant records were a useless expense that did not pay dividends.

In one such happening, the owner has seen the light, and had all the unused instruments installed and records taken therefrom, which he is referring to every month. Every owner should have such equipment installed and insist on records from them.

80% of Industrial Power Plants Lack Records

After years of contact with the field it is safe to state that 80 per cent of the industrial power plants are not equipped with records of the real basic figures on which to base comparisons of performance or costs.

They have not the equipment required to collect the data on which to base such figures.

In this day of efficiency, with almost every item of cost of manufacture carefully recorded and analyzed, the one item of the power cost is omitted. It is not a separate item, but is buried with other items bulked under the heading of "overhead" or "maintenance." Even then the cost of power is a general term which too often includes charges which have been improperly allotted to it.

Power plant costs are often made the companion of maintenance, heating, ventilation and lighting, repairs and operation, through faulty bookkeeping. More often it is because of lack of knowledge as to where to place the charges.

If the power plant were operated as a separate department and ranked with all the others, then care would be taken to allot to it the legitimate charges.

belonging there only. Basically, the boiler house should be rated as a steam department and its output charged to every other works department using it. It should be termed a steam producing department because of the direct use of this commodity in so many other departments, and also by reason of the fact that most of the power is steam generated.

In order that power plant performances be calculated, the least equipment in the boiler room should include a means of measuring the boiler feed water and the fuel which converts it into steam.

With the measurement of these two boiler room commodities we can get at the basic figures which enter into all calculations in reference to power costs. Not only will we get the total and unit costs in this way but we also will see our performances in comparison with standard practice.

There is much to be gained from records based on accurate measurement of feed water and fuel. The operating engineer can note by his daily records if he is up to the standard of operating efficiency.

Problem to Correct Deficiencies

He can set about correcting his deficiencies before they amount to a serious problem. Thus it is that daily records are very important to the proper operation of the power plant.

The records of performance are not so important to the main office as is the monthly report of power plant costs. Yet daily, weekly, and monthly power plant records cannot be had unless the plant is equipped to secure data for them.

One reason why the owner does not value the power plant, lies in the attitude of the operating engineer himself. He may be one of those lazy, shiftless men who lays back on his position of a necessary cog in the wheel of the factory organization, to apply as little effort as possible to the work of his position, and the cleanliness of his plant and person. In that event there is no *liaison* between office and power plant. The boss hates the sight of the man, sends for him only on urgent need and frequently the latter is designated by the former as "that damned engineer." The engineer is to blame here.

Managerial Indifference

On the other hand, this type of engineer is in the minority, and in the balance of cases the fault of indifference to the needs of the plant equipment lies with the boss. Some managers or owners, one or both, simply lay back on the fact that the power plant costs do not run over 5 per cent of cost of manufacture as the basis of their indifference to the subject. Yet these very men insist that every item of expense in manufacture be kept in other departments. Then there are those managers of business who look on everything connected with the power plant indifferently because of the small percentage of the costs and assume an arbitrary attitude against every suggestion of added equipment. They show this feeling toward the person of the chief operating engineer and here lies another cause of lack of team work for the common good. Here is where the boss is to blame.

The power plant may cost a small percentage of the total manufacture, and consequently needs no thought bestowed on it while it operates—so thinks the boss. Yet it can cost untold sums if it shuts down and refuses to function during production hours. For this reason it is at times too bad that a power plant is so well managed that it never shuts down during working hours. In such case the engineer never sees the manager. In the event of a shut down the engineer then meets the manager and they become acquainted.

Value of Recording Instruments

The manager would reduce costs in the power plant and add to his "insurance against shut down" right away by investing in a few recording instruments to aid the engineer to start daily records. This is as true here as in any other department that is being run without records.

There is no argument on this point. It would be a good move if all power plants in the country were put on rating and classed as A, B, C, and D plants according to their efficiency in the use of fuel. It will come to this some day. It would aid the conservation of fuel and benefit every plant in the process. Why not let it be a voluntary act on the part of the owner?

When a factory power plant supplies its own electric current for power, the steam distribution will average 30 per cent to the engine room and the balance to the factory. Thus it is that the boiler and engine room importance in recording instrument consideration should rank in like percentage.

Records of Fuel and Water

The fuel measuring and feed water metering are the first two essentials. These are absolute requirements Without the record of fuel used and water evaporated there would be no use of other records. Fuel burned and steam generated with it are the basis of all calculations of costs, performance, and comparisons.

In other records are checks and details of the first two. It would be ideal to have these two important records on each separate boiler, but this is not absolutely essential.

Of all maintenance-department records the most important are those pertaining to the power plant; all calculations of cost of power and very often matters of policy in the works are settled by findings based upon them.

The longer records are kept, the more valuable they become because of the time element in averages. Those of a few days or weeks do not so closely approximate the truth as those of a year; then the first year's averages form a basis of comparison with the second year's operation for reference and guidance.

The owner is primarily interested in costs, both average and bulk, and these are obtainable from the monthly analysis of the daily reports, a summary of the month's operation. An owner does not want test

DAILY POWER PLANT REPORT

OUTSIDE TEMPERATURE _____ °F

DATE _____ 192___

TIME	STEAM PRESSURES: BOILER ROOM	STEAM PRESSURES: ENGINE ROOM	STEAM PRESSURES: HOT WATER HEATERS	WATER PRESSURES: HOT WATER FLOW MAINS				WATER PRESSURES: HOT WATER RETURNS	WATER PRESSURES: CITY WATER	WATER PRESSURES: TO BAROMETRIC CONDENSERS	DRAFT PRESSURES: GROUP "A" BOILERS: UNDER GRATE	GROUP "A": OVER GRATE	GROUP "A": BACK PASS	GROUP "A": STACK	DRAFT PRESSURES: GROUP "B" BOILERS: UNDER GRATE	GROUP "B": OVER GRATE	GROUP "B": BACK PASS	GROUP "B": STACK	VACUUM: BAROMETRIC CONDENSERS 1	BAROMETRIC CONDENSERS 2	AIR PUMPS 1	AIR PUMPS 2	TEMPERATURES: FEED WATER	HEATING: FLOW	HEATING: RETURN	BASE OF STACKS: BRICK	STEEL STACKS: 1	2	3	4	5	COOLING POND	CONDENSER DISCHARGE
6 AM																																
7																																
8																																
9																																
10																																
11																																
12 M																																
1 PM																																
2																																
3																																
4																																
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11																																
12 MT																																
1 AM																																
2																																
3																																
4																																
5																																
6																																
AV																																

TOTAL AMOUNT STOKER RAM COUNTER READINGS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
FINISH																		
START																		
DIFFERENCE																		

METER READINGS

	FEED WATER	No.	No.	No.	No.	No.	No.	No.	No.	No.
FINISH										
START										
DIFFERENCE										

STEAM FLOW

	AIR	STEAM	STEAM	STEAM	STEAM	STEAM	STEAM	STEAM	STEAM	STEAM	STEAM	STEAM
FINISH												
START												
DIFFERENCE												

KILO WATT HOUR

FINISH							
START							
DIFFERENCE							

COAL RECORDS

POUNDS	BITUMINOUS	ANTHRACITE
ON HAND		
RECEIVED		
TOTAL ON HAND		
USED		
ON HAND		

FUEL OIL RECORD

BOILER DATA

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
NO AND SIZE TUBES																			
HEATING SURFACE	5000 sq. ft.	5000 sq. ft.	2500 sq. ft.	2500 sq. ft.	2500 sq. ft.	2500 sq. ft.	2500 sq. ft.	2500 sq. ft.	5000 sq. ft.	5000 sq. ft.	5000 sq. ft.	5000 sq. ft.	5000 sq. ft.	5000 sq. ft.	5000 sq. ft.	5000 sq. ft.	5000 sq. ft.	5000 sq. ft.	75 000 sq. ft.
H P RATING	500	500	250	250	250	250	250	250	500	500	500	500	500	500	500	500	500	500	7500
GRATE AREA	89 sq. ft.	89 sq. ft.	44.6 sq. ft.	44.6 sq. ft.	44.6 sq. ft.	44.6 sq. ft.	44.6 sq. ft.	44.6 sq. ft.	89 sq. ft.	89 sq. ft.	89 sq. ft.	89 sq. ft.	89 sq. ft.	89 sq. ft.	89 sq. ft.	89 sq. ft.	89 sq. ft.	89 sq. ft.	1335.6 sq. ft.
RATIO H. S. TO G. A.	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1

NOTES

TIME	HOURS RUN: 6A	7	8	9	10	11	12	1P	2	3	4	5	6	7	8	9	10	11	12	1A	2	3	4	5	TOTAL	TOTAL
BOILERS	1																									
	2																									
	3																									
	4																									
	5																									
	6																									
	7																									
	8																									
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	12																									
	13																									
	14																									
	15																									
	16																									
	17																									
	18																									
GENERATORS: TURBO	1																									
	2																									
	3																									
	4																									
	5																									
	6																									
	7																									
GENERATORS: Recip. recat	1																									
	2																									
PUMPS: Feed	1																									
PUMPS: Heat	1																									
	2																									
PUMPS: Coal Lift	1																									
	2																									
PUMPS: Vac. Sum	1																									
	2																									
CONDENSERS: Recip. Eng's	1																									
	2																									
CONDENSERS: Jet	3																									
	4																									
DRAFT FANS: FORCED	1																									
	2																									
	3																									
	4																									
DRAFT FANS: INDUCED	5																									
	6																									
	7																									
	8																									
	9																									
	10																									
Coal Convey																										

CALCULATIONS

TOTAL AMOUNT FUEL USED	
TOTAL AMOUNT ASH PER DAY	
PERCENTAGE ASH	
RATE OF COMBUSTION	
TOTAL POUNDS OF STEAM PRODUCED	
RATING OF BOILERS IN SERVICE	
B H P PER HOUR DEVELOPED	
PERCENTAGE OF RATING PRODUCED	
EVAPORATION PER SQ FT H S	
AVERAGE BOILER PRESSURE	
AVERAGE TEMPERATURE OF FEED WATER	
FACTOR OF EVAPORATION	
EVAPORATION PER POUND OF FUEL	
EVAPORATION PER POUND OF COMBUSTIBLE	
EQUIVALENT EVAP PER POUND OF FUEL	
EQUIVALENT EVAP PER POUND OF COMBUSTIBLE	
COST OF FUEL PER POUND	
POUNDS OF FUEL PER B H P	
COST OF FUEL PER B H P	

SIGNED _____

PLANT ENGINEER

FIG. 1 DAILY POWER PLANT REPORT FOR USE IN LARGER PLANT; ACTUAL SIZE, 11 x 17 IN.

results so much as a showing of every-day costs that he is called on to meet, whether for a department or the entire plant, and a year's average will show what may be expected in the way of attainment, and set the mark for betterment, if possible.

Commercial Costs

The commercial cost of a boiler horsepower or kilowatt-hour is what is sought by an owner, by including every item of expense that enters into consideration, with the actual every-day average performance in production. To this end the basis of all calculations is the actual evaporation of water per pound of fuel in the boiler room, and we must pay the most careful attention to the weighing of fuel and measurement of feed water. With this must be kept an accurate record of the cost of each day's fuel, following the varying market prices. The owner pays for fuel as delivered in the boiler room; if it is bad fuel, he pays for it just the same. In estimating commercial costs, we should therefore consider the actual evaporation, uncorrected, for the owner pays for the bad as well as the good.

Coal weighing is a problem that in some cases calls for considerable apparatus, but is so important that there is no need of keeping any records at all if this is not attended to. With ram stokers counters can be used on each stoker and summarized each day. Ash can either be weighed on scales as it goes out or computed after the weight of the content of containers has been ascertained. Feed-water meters are next in importance, and it is the writer's conviction that neither disc nor turbine meters are to be relied upon for feed-water measurement, as both the rate of flow and temperatures are too variable. Some well-known make of V-notch or orifice type measuring device is the best for this work and even with these the operator must not rely on the instrument giving good service without constant attention; in fact, this latter rule holds good for all kinds of recording instruments.

Boiler Room Instruments

With the coal and feed water measurement should come data to check them so that the list of equipment in the boiler room should include the following:

1. Scales. To measure fuel, hourly, and total. (Pounds, tons.)

MONTHLY ANALYSIS POWER PLANT REPORTS MONTH OF _____ 192__

	BOILER ROOM	TOTAL	AVERAGE
1	POUNDS STEAM PRODUCED		
2	BOILER HORSE POWER PRODUCED		
3	BITUMINOUS COAL CONSUMPTION		
4	ANTHRACITE COAL CONSUMPTION		
5	AVERAGE FEED WATER TEMPERATURE		
6	AVERAGE FLUE GAS TEMPERATURE (BASE OF STACK)		
7	AVERAGE BOILER PRESSURE		
8	AVERAGE FLUE GAS PRESSURE		
9	AVERAGE FACTOR OF EVAPORATION		
10	AVERAGE EVAPORATION PER POUND OF FUEL		
11	AVERAGE EVAPORATION PER POUND OF COMBUSTIBLE		
12	AVERAGE EQUIVALENT PER POUND OF FUEL		
13	AVERAGE EQUIVALENT PER POUND OF COMBUSTIBLE		
14	AVERAGE PERCENTAGE OF ASH		
	CURRENT EXPENSES		
15	COST OF FUEL DELIVERED TO STORAGE		
16	COST OF FUEL DELIV ED FROM STORAGE TO BOILER ROOM (COAL HANDL'G, LABOR & MOTOR)		
17	TOTAL COST OF FUEL TO BOILER ROOM		
18	WAGES OF FIREMEN AND WATER TENDERS		
19	WAGES OF BOILER REPAIR MEN		
20	WAGES OF LABOR AND FIREROOM ENGINEER (LEAVING OUT COAL HANDLING)		
21	GENERAL SUPPLIES		
22	REPAIRS (ASIDE FROM BOILER REPAIR WAGES)		
23	LIGHT		
24	POWER ALL MOTORS IN BOILER ROOM)		
25	GENERAL EXPENSES		
26	DEPRECIATION (BALANCE OF 10% ON EQUIPMENT ADDED TO ITEM 22)		
27	INSURANCE (FIRE)		
28	INSURANCE (BOILER)		
29	INSURANCE (EXPLOSION)		
30	TAXES		
31	STEAM FOR FEED PUMP		
32	TOTAL COST OF STEAM PRODUCTION		
33	COST OF COAL PER POUND		
34	POUNDS COAL PER B. H. P.		
35	COST OF COAL PER B. H. P.		
36	TOTAL COST PER B. H. P.		
37	COST OF EVAPORATION PER 1000 LBS. STEAM		

NOTES

FEED PUMP OPERATION SUPPLIES AND REPAIRS TO BE INCLUDED IN ITEMS 30, 22, 27, 28
FEED PUMP STEAM TO BE CHARGED AT COST PER 1000 LBS
MAINTENANCE, OPERATION AND TAXES OF HEATING SYSTEM TO BE DEDUCTED AND CHARGED TO HEATING

	ENGINE ROOM	TOTAL	AVERAGE
1	TOTAL KILO WATT HOURS PRODUCED		
2	KILO WATT HOURS PRODUCED FOR LIGHT		
3	KILO WATT HOURS PRODUCED FOR POWER		
4	TOTAL STEAM USED FOR GENERATORS AND AUXILIARIES		
5	KILO WATT HOURS PURCHASED FOR LIGHT		
6	KILO WATT HOURS PURCHASED FOR POWER		
7	TOTAL KILO WATT HOURS PURCHASED		
8	AVERAGE VOLTAGE		
9	AVERAGE WATER RATE PER KILO WATT HOUR		
10	AVERAGE POUNDS COAL PER KILO WATT HOUR		
	CURRENT EXPENSES		
11	WAGES, ENGINEERS, ATTENDANTS, LABOR (INCLUDING COOLING POND)		
12	COST OF STEAM FOR GENERATORS AND AUXILIARIES		
13	COST OF POWER FOR PUMPS AT COOLING POND		
14	GENERAL SUPPLIES		
15	REPAIRS		
16	LIGHT		
17	POWER		
18	GENERAL EXPENSES		
19	DEPRECIATION		
20	INSURANCE (FIRE)		
21	INSURANCE (EXPLOSION)		
22	TAXES		
23	TOTAL COST OF KILO WATT HOUR PRODUCTION		
24	TOTAL COST PER KILO WATT HOUR		
25	COST OF PURCHASED LIGHT		
26	COST OF PURCHASED POWER		
27	TOTAL OF PURCHASED CURRENT		

NOTES

ITEM 12 ESTIMATED AT RATE OF ITEM 37 IN BOILER ROOM

SIGNED _____
PLANT ENGINEER

FIG. 2 MONTHLY ANALYSIS OF POWER PLANT REPORTS. ACTUAL SIZE, 8½ x 11 IN.

2. Feed water meter, or steam flow meter. To measure the pounds of steam evaporated.

3. High pressure recording steam gage. To record average steam pressure on boiler lines.

4. Recording feed water temperature gage. To record the average temperature of feed water in degrees Fahrenheit.

5. Recording flue gas temperature gage. To record the average temperature of flue gas in degrees Fahrenheit.

6. Recording draft pressure gage. To record average flue gas pressure in fractions of an inch, water pressure.

7. Recording low pressure steam gage. To record average steam pressure on heating system in pounds of gage pressure, and the total heating hours.

Additional uses of the above and notes on installation are:

1. The same scales used for coal weight can be used for the ashes. Where the coal is weighed by other device than scales, a separate scale can be used for the ash.

2. A feed water meter on the main line from pump to boilers can measure the total feed water. All leaks through blow-off lines, etc., must be checked where the feed is measured this way. The steam flow meter on the steam header can measure the feed and is not affected by blow-off leaks. To measure the total steam evaporated in a boiler room by means of a steam flow meter on the header, requires that all the steam flow in one direction by the meter before it is distributed. If this cannot be, then meters must be placed on each separate boiler or steam flow meters give place to the one feed water meter on the main feed line.

3. This gage should be attached to the steam header in the boiler room.

4. This should be placed on the boiler side of any feed water heater.

5. This should be attached to breeching next to stack.

6. Where only one is used, it should go in main flue next the stack.

7. This should go on main feed line to any heating system and on the low pressure side of any reducing valves. If the heating is by hot water there should be combined pressure and temperature. Recording gages on both the flow and return lines to record these data. In this event, the yearly heating hours can be taken from them.

The orifice type of flow meter has been so perfected that it gives accurate readings year after year. This brings the cost of feed water and steam measurement well within the reach of the smallest power plants.

With this equipment data can be gathered for daily power plant reports such as shown in Fig. 1. This is a sample of a large plant record sheet and is generally simplified when applied to the average sized factory power plant.

To the data gathered from records on these sheets should be added details of boiler data.

Machine hours run such as boilers, engines, generators, pumps, etc., are recorded by the engineer in charge as part of the original operating data.

With the data thus gathered and in conjunction with the accounting department, the engineer can then calculate his operation in the following details:

1. Total fuel used. Tons (net or gross) and pounds.
2. Total ash. Pounds.
3. Percentage of ash.
4. Rate of combustion.
5. Total pounds of steam produced.
6. Rating of boilers in service.
7. H. P. per hour developed.
8. Percentage of rating produced.
9. Evaporation per sq. ft. h. s.
10. Average boiler pressure.
11. Average temperature of feed.
12. Factor of evaporation.
13. Evaporation per pound of fuel.
14. Evaporation per pound of combustible.
15. Equivalent evaporation per pound of fuel.
16. Equivalent evaporation per pound of combustible.
17. Cost of fuel per pound.
18. Pounds of fuel per B. H. P.
19. Cost of fuel per B. H. P.
20. Average draft pressure.
21. Average flue gas temperature.
22. Efficiency of boiler and grate.[1]

These daily power plant reports also furnish all the data with which to make up graphic charts of any phase of operation or costs. Many executives will look at a daily report in chart form but lay aside the sheet of figures.

The daily reports are of the most value and interest to the management and owners when compiled into a monthly analysis such as outlined in Fig. 2.

Answers to All Questions

The outline given here of forms for daily and monthly reports with a list of subjects to be calculated, only covers a part of the latter. The point is this: if one will invest in the necessary instruments with which to collect the data for these reports, and put the latter in force, every question in relation to power can be answered there. Production standards obtained, comparison with the best, improvement without loss of time, itemized cost of horse power production, cost of heat, ventilation, illumination, established costs on which to base improvements in capacity of power plants or power additions in other departments, all and more can be settled with these records. All that is needed for this is a few necessary instruments as outlined here and the establishment of a system of records.

With this start the engineer becomes more self respecting and the employer more appreciative of him and his department. Once started, both parties will see more places where they will want information and will not hesitate to equip to get it.

[1] To compute the efficiency, the analysis of the fuel must be made by the chemist and this is generally made on a separate report sheet.

Accounting for Values or Dollars

By STEPHEN McKENZIE DuBRUL

A RECENT bulletin of a business service contained a discussion of depreciation reserves, in answer to the following question.

> Considering that depreciation reserves, based upon the actual cost of buildings and machinery acquired before the war, fall far short of the cost of replacing them today, why is it not desirable to base depreciation on replacement cost rather than actual cost?

While admitting the desirability of such a procedure from a financial standpoint, the writer of the bulletin objects to it on the basis of accounting theory and "practicality." He seems to consider the question as one which can be dismissed with a few casual remarks that "accounting theory does not allow such a method and the Income Tax Bureau would not permit it."

Let us consider this question from the viewpoint of the owner of a business. When an investor puts capital into a concern, he invests purchasing power. Suppose, that in 1914 $100,000 were invested in plant assets on the assumption that they would earn 10 per cent net per year, plus depreciation of the assets so purchased of 3 per cent. In 1924, therefore, these assets were calculated to be worth $70,000. But the purchasing power invested was measured in terms of 1914 dollars, not 1924 dollars. So to determine the value in 1924 we must take the 1924 cost of replacing the assets by others equally productive less the depreciation. The purchasing power of 1924 dollars was roughly about two-thirds as much as that of 1914 dollars. Therefore (ignoring obsolescence), the cost of replacement was $150,000. To replace the depreciation of 3 per cent for 10 years, requires $45,000 in 1924 dollars, and the net value of the assets in terms of 1924 dollars was $105,000. Unless $45,000 is available for replacements the owner's capital is really impaired. In 1914, these assets earned $13,000, or 13 per cent. Therefore, to return the same amount of purchasing power to the owners in 1924 as was done in 1914, the earnings, in terms of 1924 dollars, must be $15,000 net, plus $45,000 for depreciation, or a total of $19,500.

Padding the Profit Account

Suppose that the concern did actually earn gross $19,500 in 1924 or 13 per cent on the 1924 valuation. If we are to allocate this return as between profit and depreciation on the basis of cost, our accounting simply deceives the stockholder by padding the profit account. Such a method violates one of the first principles of statistics, which is that valid comparisons can be made between quantitative data, only when the data are homogeneous. We make very false comparisons when we use 1914 and 1924 dollars as though they were equivalent.

Men who persist in making such comparisons conceal the fact that variations in the purchasing power of money must affect the solution of problems involving the comparisons of values between different years. The case is clear, and yet there are accountants who maintain as an infallible rule of their profession that the value of all assets must be stated in terms of their cost in dollars and that no account may be taken of the changes in the value of money. Does this sort of accounting perform its true function, which is to account to the owners for *all* changes in values which occur within the business? Mere accounting for the dollar marks on books does not give owners a true accounting of the value of their property, because the measure of value, the dollar, is constantly and at times rapidly changing.

Physical Standards Require Standard Conditions

Even in physics, the standard measure is standard only at a standard temperature, and corrections are applied accordingly. Is it not ridiculous that accountants who pretend to a scientific standing, persist in ignoring such a basic fact that their unit of measurement (in this case the dollar) is constantly varying in size?

Too many accountants say that the method of revaluing assets in terms of their current money values is impracticable. Accounting for values cannot safely be entrusted to such men. Instead of denying that it can be done, and continuing to keep their accounts incorrectly, scientific accountants face the problem squarely and develop adequate methods for dealing with it. It is true that this makes financial accounting more involved, and cost accounting even more so than financial accounting, but the results are worth the cost for *they are true!*

Business needs the universal adoption of accounting for values which alone stops this deception of owners. Consider what the effect of it would have been had it been common practice during 1919 and 1920. If all manufacturers and business men who had investments in fixed assets had calculated their depreciation on this basis, they would have soon realized that their profits were not nearly as great as they appeared to be and the dangers of currency inflation would have been greatly mitigated.

The one really important, practical consideration is that of income tax procedure. That difficulty could be surmounted, however, if businesses were to keep two sets of books, one for the management and owners, according to the true methods advocated above, and another for the Government, kept according to the methods insisted upon by Congress and the Tax Unit. Only the first set is of use in determining questions of policy. In time, as business men become educated to thinking in terms of values and not just dollars, even Congress would be educated, and the Income Tax Laws would be changed.

The Modern Manufacturing Plant

E. R. Squibb and Sons Complete the First Unit of a Thoroughly Planned New Building Program at the Brooklyn Plant

THE original plant of E. R. Squibb and Sons, manufacturers of chemical, pharmaceutical, biological and toilet products, was built at the present location in 1856. Besides establishing additional factories at other points, it has been necessary at several times to enlarge and add to the first structure. During 1924 and 1925 the last new building, shown in Fig. 1, was constructed, and it is this building which is described in the present article.[1]

When the need for a new building first was indicated, data were collected on labor market, transportation facilities and operating costs in various places that might be considered. Relations with other plants and laboratories of the company were thoroughly studied, with the result that the site of the original Brooklyn laboratories was deemed the most advantageous for further development. Ample space for future expansion was assured by the purchase of about a square block of property across the street from the present buildings. The requirements of present and future manufacturing, and probable developments in equipment and processes were carefully studied. New products that might be developed and probable growth of the business were visualized. When all of this material was fully organized it was used as the basis of a building program planned for many years to come. The new building is the first big step in this program.

FIG. 1 NEW BUILDING OF E. R. SQUIBB AND SONS

The layout of the new building followed a comprehensive system of manufacturing carefully mapped out. This layout, made by those in executive charge of the plant, was used by the architect in drawing up construction plans and specifications for the building.

The company owns two adjacent blocks on Columbia Heights near the East River waterfront in that part of Brooklyn facing lower Manhattan. The new building occupies the entire end of one of these blocks and covers a ground area of 93 x 130 feet. It is 13 stories high and is built of reinforced concrete throughout. The floors are level with those of the older buildings and connect with them up to a height of six stories, which is as far as the older buildings extend. The basement was omitted to simplify construction problems.

Local building laws required that successively at the ninth, eleventh and thirteenth stories the walls must be stepped back several feet from the building line. It was possible to do this and at the same time produce a pleasing architectural effect. A number of large water tanks, two of them of 40,000 gal. capacity had to be located on or above the thirteenth floor. See Fig. 2. These are respectively for sprinklers, fire lines, house water, well water, purified city water, and distilled water. Three tanks extend to a considerable height above the roof. In order to harmonize the construction with the rest of the building and to take advantage of the advertising opportunity offered, these three tanks have been enclosed within a large sheet metal structure, square at the base and rising to a height of 56 ft. above the roof. The company's seal in copper and gold leaf has been placed on the four sides at the upper end of this structure, and by means of a series of concealed flood lights extending from the thirteenth story down to the tenth story, the entire upper part of the building is illuminated at night in changing colors.

The walls of the building, inside and out, are of concrete. Daylight construction was adopted, and steel sash extends from a point about 3 ft. above the floor up to a height of 10 ft. 6 in., or a few inches below

[1] Data for this article were furnished by F. W. Nitardy, General Superintendent, E. R. Squibb and Sons, Inc., Brooklyn Plant.

the ceiling. Panes 12 x 18 in. in size are used. The upper row in each case is of wire glass because fire regulations demanded at least 4 ft. of fire-resisting construction between the tops of the windows on one floor and the bottom of the sash on the next floor above. Transparent glass was used in the remainder of the sash to take maximum advantage of the daylight, and to give workers a chance to relieve their eyes by occasionally looking out of the windows.

The floors of the plant are of 7½ in. reinforced concrete with special wear- and dust-eliminating surface. They are of a flat slab construction supported on mushroom-type columns. See Fig. 3. The distance from floor to floor was made 11 ft. 6 in. to match with the older connecting building, leaving a clear height of 10 ft. 10½ in. between floor and ceiling. Special care was taken to keep all piping close to the ceilings to gain all the clearance possible within this necessarily restricted height. The floors are provided with drains in every 18 by 18 ft. square section between columns and are pitched toward these drains at a very slight slope. Any water and liquids from industrial processes are thus carried off without difficulty. The floors are cleaned by washing down frequently with a hose. The concrete ceilings were kept smooth for the sake of cleanliness and appearance by the use of steel forms when pouring, instead of the usual wood forms

The walls of the plant are painted a very light buff color with a chocolate-brown section extending from the floor up to a height of 3 ft. to prevent discoloration of the lower portion. The ceilings are painted white. In the offices the brown strip extends only 9 in. above the floor.

Partitions have been necessary in many sections of the plant to enclose special processes, laboratories, the office sections, etc. These partitions are of terra cotta, plastered on both sides.

There are two large main stairways in the building, one at each end. The stairways are entirely enclosed and serve both as fire exits and for communication between floors. The steps and landings are of concrete and the treads have steel safety strips to prevent wear. Railings are of 2 in. galvanized pipe. The stairway at the front of the building is reached through a short passageway on each floor, open to the air. The stairway at the other end of the building adjoins the passenger and freight elevator shafts and is reached through an enclosed passageway leading to them.

Doors throughout the plant are of a fire-resisting make. Some are hinged, some run on overhead track, and all automatically close in case of fire. Those leading to the elevators and stairways are tin-clad and those leading to the various departments and rooms are kalamine. Some office doors are of wood (for appearance) and those on the exterior of the plant are partly kalamine and others bronze. Elevator doors are of the vertical lift type, split at the middle so that one half raises while the other half lowers.

Natural ventilation is employed. Each window consists of four sections of steel sash, 5 panes high, the two in the middle being four panes wide and the two at the end three panes wide. Each of these sections contains a ventilating sash, 3 ft. high, hand operated by means of a chain, and admitting ample fresh air.

In the research and testing laboratories and in many of the manufacturing operations fumes are generated which must be carried out of the building. Rectangular, galvanized sheet piping carries these fumes over to ventilating chimneys, eight of which extend up through the building at various points. Natural draft carries off the gases from many of these ducts, while in others fans must be used to maintain the circulation.

General lighting is provided by a direct system using metal RLM reflectors. The lights are mounted

FIG. 2 VIEW ON THE 12TH FLOOR, SHOWING TANKS

midway between columns and thus the equivalent of two lights (half the light from four lights) illuminates each section of the floor space within the area marked off by four columns. The lights are at 18 ft. centers and 100- and 200-watt lamps are used according to need. Each light has an individual chain shut off, groups may be switched on and off by convenient local controls, and a whole floor may be cut out by means of the switches in the control box at either end of the floor. The lights hang 18 in. below the ceiling or just a little more than 9 ft. above the floor.

For equipment such as packing machines and conveyors the standard scheme of lighting is varied and lights are located where they will illuminate the work being done. Office lights are similar to shop lights except that they are ornamental and have distributors

Heating is done by means of steam generated at 120 lb. pressure and reduced to 5 lb. for use in the radiators The power plant is located across the street from the new building and steam is carried over in an 8 in. main to the first floor of the building. Here it goes through the reducing valve and to the risers which carry it to the wall type radiators on each floor.

A great deal of steam is required for manufacturing purposes in the stills, kettles and other industrial equipment. This steam is taken from the power house main in the basement of the new building at a pressure of

80 lb. and is carried to distributing mains on the ninth floor which is midway of the several floors requiring steam in manufacturing processes. The risers go up a well at one end of the building installed specially to carry main lines of piping to serve the various floors of the building.

The condensate from the heating mains and from the industrial equipment using steam is collected into high pressure and low pressure return systems respectively and is returned to the power house. Here the low pressure returns pass through an open feed water heater and are pumped back into the boilers. The high pressure returns pass into the boilers by means of Bunde traps.

Previous to the erection of the new building the plant generated its own electricity as well as supplying steam for manufacturing and steam heating purposes. The power equipment had been installed for a number of years and consequently was of a type fast becoming obsolete. Therefore to continue supplying current would have necessitated new generating equipment. Before going to this expense it was decided to study power costs. The figures revealed that it was cheaper to purchase power from the Brooklyn Edison Company and run the boilers at a higher rating during the winter in order to get the necessary extra steam for heating. This plan was therefore adopted.

The equipment in the power house consists of two 250 hp. water tube boilers with stokers, open feed

FIG. 3 DENTAL CREAM FILLING DEPARTMENT

water heaters, feed water pumps and the usual control instruments. Buckwheat no. 3 coal is ordinarily burned, but at the present time river coal is being very successfully utilized. This coal is delivered in barges at a nearby wharf and is trucked to the storage yard. A power hoe operated for about an hour a day conveys coal from the storage yard to the boot of a bucket elevator which carries it up to a 20-ton steel storage bunker. From this point it is delivered through a weigh larry to the stoked feed hoppers.

Ashes fall from the back of the grates into hoppers beneath the boilers. These hoppers discharge into a vacuum ash conveyor which elevates them to an overhead tank. The exhaust from the tank discharges into the chimney. Ashes are removed by trucks when the storage tank is filled.

An incinerator has been installed to take care of rubbish. An old chimney serves to furnish draft and carry away the fumes, and an adjacent abandoned elevator shaft extending up 6 stories in the old plant forms the feed chute. Wastes and rubbish collected from all floors of the plant during the daily cleaning by the janitors are carried on trucks and dumped in the nearest opening in this chute.

Chemical machinery has reached a high state of development and each installation is usually a complete independent unit. Hence direct motor drives and accessory equipment such as pumps, air compressors, air washers, etc., are in most cases provided with the installation. Some machinery in the plant, however, has to be driven by belting and for this purpose overhead shafting is suspended from the ceiling by means of special inserts left in the concrete when it was poured, so that bolts could be attached. Such machinery is usually arranged in groups so that one motor can drive several pieces of apparatus.

The plant is built of fire-resisting materials throughout. It is completely sprinklered and in addition has a fire main running up through the stair well at each end. To this main fire hose is attached on every floor so that a stream of water can be directed wherever necessary. Fire pails and extinguishers are also supplied. Stairways, elevators, passages to elevators, openings to the old building, and special departments partitioned off, are protected by fire-resisting doors.

The material handling system in use is comprised of elevators, conveyors, chutes and trucks. Some processes of manufacturing have gravity handling intimately tied in with the processes themselves.[2]

A complete combined signal and time clock and watchmen's system is being installed. It will provide a master clock regulating electric clocks in all the departments, a program clock to ring bells at opening and closing time and during the lunch hour, a complete fire alarm system, a recording system for the watchmen's rounds, a door bell signal operating when the factory is closed, a watchmen's plug-in telephone system, and an autocall for executives. Regular communication is provided by means of telephones in various departments, connecting with each other and with the outside.

Pedestal, bubbler-type drinking fountains with ice-cooling attachment are located on every floor. Each floor has also men's and women's locker rooms and toilets, entered from the hallway leading to elevators and stairs at one end of the building, and partitioned off from the manufacturing departments. Wash bowls, closets and urinals are of the most modern sanitary type, special care and cleanliness being required in a plant making drugs and toilet products.

[2] The material handling methods represent the result of careful and thorough study, and will be the subject of a subsequent article.

In the departments where girls can sit down at their tasks, such as packing products, metal chairs with special wood backs have been provided. Shelving and racks moved over from the older building are of wooden construction. New equipment is of steel.

All machines and equipment where accidents are at all likely to occur are protected by guards made of wire mesh on steel angle framework. Aisles are marked off by white guide lines painted on the concrete floor to keep obstacles out of the way of trucks and make the passageways safe.

The plant employs a great many girls, and rest rooms are provided for their convenience during noon hour and recess periods. A cafeteria with complete equipment is located on the top floor of the older building. It will accommodate about 200 at one time. The tables have porcelain tops and the chairs are swiveled to the table legs. Each table seats four people. This room is also used for social gatherings and monthly get-together suppers of the executives and department heads of the laboratories and plants, to discuss important problems related to plant operations and manufacturing methods.

A hospital and dental clinic are located in a room on the first floor of the original building. The nearness of good city hospitals makes extensive equipment unnecessary, but everything is provided to give immediate medical or surgical attention.

The architect for the new building was Shirley Morgan, Associate Professor of Architecture, Princeton University. The engineering work was done by Russell G. Cory, and the contractor was the Turner Construction Company.

TABLE 1. SUMMARY OF DATA ON E. R. SQUIBB AND SONS PLANT

Location	Brooklyn, N. Y.
Construction	Reinforced concrete. Mushroom type columns with extra steel to cut down diameter. Concrete walls and flat slab floors. Beam construction used in upper stories to support tanks.
Property	Two blocks, respectively 96 x 350 ft. and 145 x 300 ft.
New building	93 x 130 ft.
Height	Thirteen stories, 154 ft., with enclosure on roof for tanks rising 56 ft. higher.
Floor area	139,450 sq. ft.
Architecture	Modern Metropolitan industrial type, daylight construction.
Neighborhood	Partly industrial and partly residential.
Employees	Total in plant and office 750. About half are girls.
Transportation facilities	Truck service. Railroad siding to be provided later.
Entrances	Main entrance to offices. Exits to street at foot of each of the two main stairways. Building connects at each of the first 6 floors with older part of plant.
Walls	Concrete inside and out. Finished smooth by use of steel forms in casting.
Windows	Entire walls between rectangular pilasters and from a height of 3 ft. to within a few inches of the ceilings are occupied by steel sash windows. End windows smaller, to strengthen corners of building.
Glass	Panes 12 x 18 in. Sections respectively 4, 3, 3 and 4 panes wide, each section having a ventilating sash 2 panes high. Transparent glass except for upper row of panes, which are frosted wire glass for fire protection.
Doors, exterior	Main entrance bronze, others kalamine with panels of plain glass in upper portions. All open on street.
Doors, interior	Doors to stairways and to elevator passageway are kalamine and swing on hinges. Hinged kalamine doors are likewise used between departments, between shops and offices, and in the offices. Some kalamine doors in the plant run on overhead track, to save room. Elevator doors are tin-clad, split in the middle and open vertically. Peelle type.
Roof	Concrete, covered with tar paper and tar and gravel, on 9th, 11th, 12th and 13th floors, where building is stepped back. Cast iron and wire glass skylights inserted for light.
Ventilation	Ventilating sash in windows, chain operated.
Painting	Walls and columns chocolate-brown to a height of 3 ft., light buff above this, ceilings white. In offices the brown strip is 9 in. high, walls are buff and ceilings white except main entrance, reception room and superintendent's office, which are fitted with Welch quarry tile floors, Caen stone and plastered walls, ornamental plastered ceilings, etc.
Floors, shop	Concrete, 7½ in. thick with Master Builders finish to eliminate dust and wear. Sloped slightly toward a drain in each space midway between columns at 18½ ft. centers to facilitate washing.
Floors, office	Entrance lobby, waiting room and superintendent's office have floor of 2-in. tile laid on concrete. Rest of floors are concrete with Master Builders finish.
Ceilings	Concrete, kept smooth in casting by the use of steel forms. Cast with inserts for the insertion of hanger bolts, etc. Drains from floor above, steam and water piping, ducts from ventilating hoods, power wiring conduit, etc., are suspended from ceilings. Light wiring conduit cast in slabs.
Partitions	Terra cotta, plastered on both sides. All partitions extend from floor to ceiling.
Stairs	Concrete and steel, with Feralum tread, and 2-in. galvanized pipe railing. Concrete landings.
Lighting	Direct system. RLM metal reflectors. Mounted along center lines of columns at 18 ft. centers and about 9 ft. 6 in. above floor. 100 and 200 watt lamps (with average per socket of 150 watts) used. Special arrangements of lights made where conveyors, etc., require a change from the normal in spacing or location.
Heating	Steam generated at 120 lb. and reduced to 5 lb. in building for use in wall type radiators. Local valve regulation. Vacuum pumps on return line.
Process steam	Generated at 120 lb. and reduced to 80 lb. for use in manufacturing equipment. Returns delivered to boilers by means of Bunde traps.
Boilers	Two 250-hp. Babcock and Wilcox boilers.
Stokers	Coxe.
Stack	Brick, 180 ft. high, 5 ft. inside diameter at top.
Water purification	Chemical treatment in manufacturing department.
Pipe covering	85% magnesia and asbestos.
Coal handling	Power hoe, bucket elevator, storage bin and weigh larry, discharging to hoppers on stokers.
Ash handling	Vacuum ash conveyor discharging to overhead tank.
Power facilities	Substation at plant.
Fuel storage	Buckwheat or river coal delivered by truck from barges to storage yard at power house.
Compressed air, etc	Individual machine units are supplied with compressors, pumps, air washers, etc., as required.
Line shafting	Carried on hangers from ceiling, where used. Most machines are direct driven.
Water supply	City water is supplied and is pumped to a tank on the roof by means of two 20-hp. 250 G.P.M. centrifugal pumps in the basement. Some water is chemically purified and some is distilled for manufacturing purposes, and roof tanks store the supply. Well water is pumped to a tank on the roof for circulating in condensing equipment. A 75-hp. centrifugal pump supplies the sprinkler system storage tank, and a centrifugal fire pump feeds the tank connected to the hose lines.
Elevators	Otis freight elevator and Otis combined freight and passenger elevator.
Package chutes	Otis type, 3-4 spiral each, serving all floors from the 8th down.
Conveyors	Dow gravity roller conveyors serve filling stations for products, and packaging and shipping operations. Apron conveyors under street carry shipping containers to truck platforms.
Lift trucks	Hand type.
Fume collectors	Hoods and rectangular galvanized ducts convey vapors to 8 chimneys rising to roof, some operate by natural draft, others equipped with suction fans. Ducts in most cases extend through chimney separately to roof.
Sprinklers	Installed throughout entire plant. About 400 noncorrosive heads used in various special places about the plant
Fire extinguishers	Babcock type, placed at convenient points.
Fire pails	Used at many places where quick service is needed.
Fire hose	One 100-ft., 2½-in. hose at each end of each floor, in the fire tower stairway.
Storage shelving	Sections transferred from old building are wood. New equipment is steel.
Factory chairs and stools	Metal legs with wood seats and backs.
Signaling system	Complete Autocall system installed, which provides for a master clock, electric clocks in all departments, a program clock to ring bells in morning and at night and signal the various department lunch hours, a call system for executives throughout the plant, a fire alarm system, watchmen's recording system, watchmen's plug-in telephone system, and a doorbell ringing throughout the plant during hours when it is closed.
Blinds	Venetian type used on office and laboratory floors where work is done near windows and glare must be cut out.
Safeguards	Wire mesh on steel angles, for machines. Aisles painted with white strips to regulate traffic and keep obstructions out of passageways.
Wash bowls	Individual type, porcelain.
Closets and urinals	Porcelain.
Toilet partitions	Steel. Mounted with 12 in. clearance from the floor.
Drinking fountains	Pedestal bubbler type with cooling attachment.
Hot water heaters	Steam heated.
Lockers	Individual steel locker for each employee.
Plant communication	Bell telephone system connecting shop and office, and outside.
Time system	In and out times recorded on electrically controlled time recording clocks.
Hospital equipment	Metal type furniture and cabinets. Couch but no beds provided.
Dental equipment	Complete dental office for extractions and filling of teeth, making bridge work, etc.
Cafeteria equipment	Porcelain top tables, seating 4 persons. Swivel chairs mounted on table legs. Ranges, steam table, and complete kitchen and dining ware equipment to take care of 200 at a time.
Rest rooms	Provided for girls, and in use during recess and lunch hours.

New Method of Indicating Fatigue*

By Measuring CO_2 in Exhaled Breath

BY WALTER N. POLAKOV

President, Walter N. Polakov & Co., Inc.

INDUSTRIAL fatigue is recognized as the cause of: (*a*) Reduction of quantity and quality of output, and (*b*) Reduction of strength and vitality of workers. The first part of the problem has been studied since Taylor's time studies indicated the necessity of rest periods for the maximum output. The second part has received a great deal of attention abroad and at home, particularly during the war, when conservation of labor became an economic necessity. The laboratory and field researches of physiologists are presenting a practical problem to management engineers in which are two highly important questions:

1. Is the relation between the work done and the carbon dioxide exhaled in the breath such as to offer an index of fatigue?
2. If so what is the technique of observations which will offer a simple and practical guide for management engineers in solving their problems?

In the author's observations on two firemen, Clee and Clark (Fig. 1), both men were stoking two hand-fired 250-hp. boilers, firing per hour from 1700 to 2000 lb. of bituminous coal and using shovels holding 23 lb. The boilers carried a fairly uniform load of 125 per cent of rated capacity and obtained during the period of observation an equivalent evaporation of 10.46 lb. of water from and at 212 deg. fahr. with coal containing 14,100 B.t.u, i.e., maintaining the thermal efficiency of the boiler plant at 72.0 per cent. Ashes were removed from the ashpits by means of long-handled shovels once a shift (work hours from 7 a.m. till 3 p.m.), while the fires were worked and leveled and clinkers removed during the shift as conditions demanded. These operations were noted and marked on Fig. 1 with symbols.

The samples of exhaled gas were taken every 30 minutes by direct exhalation into the hand air pump and by collecting the pure sample of 50 cc. in the hand CO_2 analyzer. In order to obtain data on the relation existing between the nature of work done and the gas metabolism, the author had to sacrifice volumetric measurements as too cumbersome for actual shop practice. This, however, was not deemed detrimental as he intended merely to develop a handy shop method which would serve with a sufficient approximation two purposes:

* Condensed from a paper presented by the Management Division at the December 1925, meeting of the American Society of Mechanical Engineers.

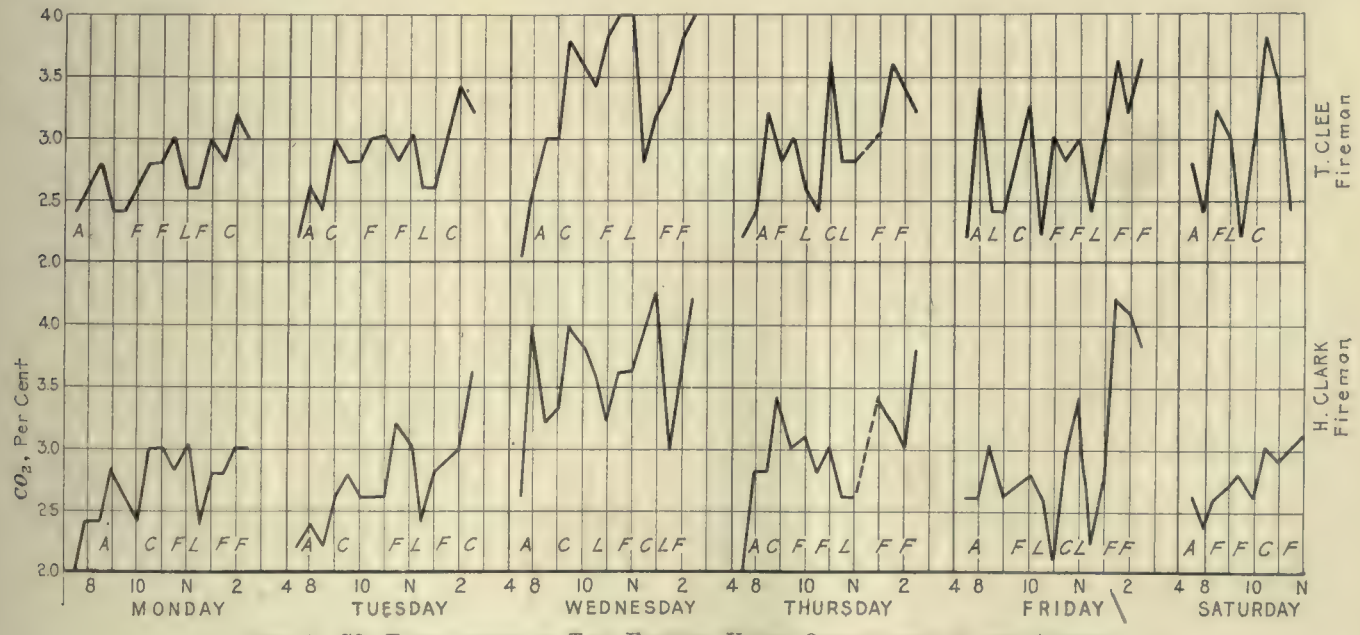


FIG. 1 CO_2 EXHALATIONS OF TWO FIREMEN UNDER OBSERVATION BY THE AUTHOR
A—Ash removed. C—Clinkers taken out. F—Fires worked or leveled. L—Lounging or lunch.

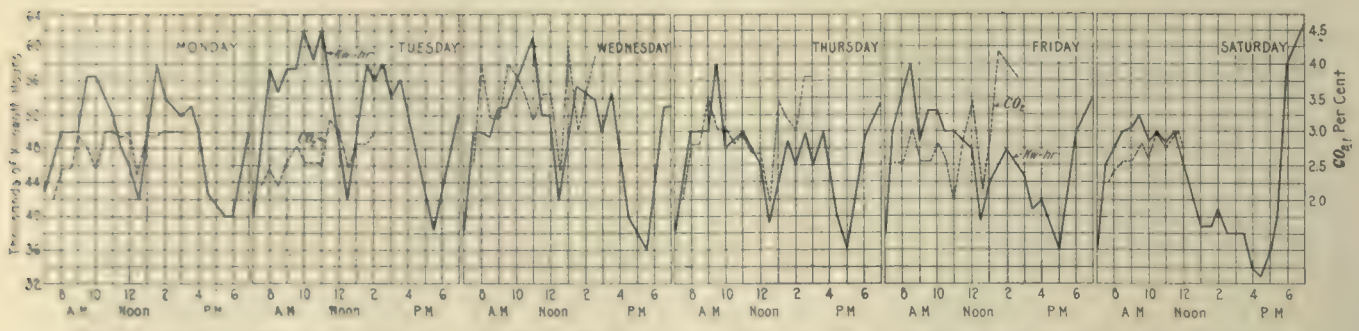


FIG. 2 AVERAGE POWER LOADS ON A CENTRAL STATION AND AVERAGE CO_2 CONTENT OF FIREMEN'S EXHALATIONS

1. To establish a simple, practical method applicable in work-a-day factory environments.
2. To use this method for the strictly utilitarian purpose of so modifying existing working habits as to reduce the strenuous elements of productive work.

In order to further investigate the accumulation of fatigue of industrial workers over a longer period of time (week as a unit), the author combined a number of such observations made on workers in various industries at different occupations and secured an average closely corresponding to his observations on firemen. These data were plotted against the curve of power consumption from a public-utility plant in central Pennsylvania, based on the average annual records of Monday's load by hours, Tuesday's load by hours, etc., as used by a large variety of industrial plants which were customers of this central station.

From this very instructive comparison of curves showing exhaled CO_2 (broken-line) and electric power used (solid-line), it appears that (see Fig. 2):

a. On Mondays the worker is still under the influence of the incitement and is slow to develop the maximum of output in the morning hours but "warms up" in the afternoon. CO_2 (uncorrected for body functions) reaches 3 per cent and is fairly constant.

b. On Tuesday the productive work reaches its maximum, while the rested workman exhales a minimum of CO_2, with an average of 2.7 per cent.

c. On Wednesday the accumulation of fatigue begins to show, as work is slow to reach its peak in the morning and declines in the afternoon; the average CO_2 rises to 3.5 per cent, with peaks reaching and exceeding 4.0 per cent.

d. Thursdays indicate further effects of fatigue in the industrial community characterized by only one peak of short duration in the morning and low, sluggish work in the afternoon, while the CO_2 exhaled is also on a decline, showing that the workman is "sparing himself." The correspondence of ups and downs of both output and CO_2 curves is suggestive.

e. Fridays are most typical of exhaustion of the vitality of the industrial community. After a determined effort in the morning of very short duration, the work falls off from hour to hour steadily, from whistle to whistle, with even the lunch recess bringing no rest or new vitality. At the same time the CO_2 curve is most interesting as it shows retarded metabolism in the morning only slightly above what would be expected from men at rest, while in the afternoon when efforts to spur up the work are made, the percentage of CO_2 reaches sharply 4.2 per cent and then only gradually declines, leaving the impression of continual exertion of fatigued men.

f. Saturdays again show the surprisingly close relation between spurts in work and high peaks in CO_2 exhaled.

Inasmuch as the acquisition of skill at mechanical operations corresponds with more precise motions and the elimination of useless strain and unco-ordinated movements, it was expected that the CO_2 in exhalation might also serve as an index of the successful training of workers at manual operations. The results obtained with a green man from the farm after one hour of training and six weeks later were as follows:

CO_2 in exhalation after first hour of training, 4.3 per cent.
CO_2 in exhalation after one hour after 6 weeks, 2.7 per cent.

From these studies the author feels warranted in drawing the following preliminary conclusions:

1. Maximum CO_2 in exhalation is an index of full load on the muscles.
2. Decrease of CO_2 content in spite of continued work indicates overload and is a signal of fatigue.
3. Age and size of the worker influence the CO_2 content. The younger and lighter men produce more work with the same CO_2 discharge than the older and heavier men.
4. Peaks in the CO_2 curve immediately follow exertions.
5. Training of workers considerably reduces CO_2 exhalation for the same release of productive work.
6. The efficiency (biological) of work decreases and the expenditure of energy per unit of work increases as work continues. (per day or week).

The conclusion cannot be escaped that the convenience, simplicity, and accuracy of indications obtained by the CO_2 analysis method offer a means heretofore unavailable to reduce the fatigue resulting from (necessary) work motions by readjusting operations or by providing labor-saving means.

Ways of Obtaining the Best Lighting

How to Plan Factory Illumination and Upkeep of Equipment

By A. G. ANDERSON

Research Engineer in Industrial Management, University of Illinois

ONE of the important points to consider in connection with factory lighting is that of keeping the light source clean.[1] The service rendered by both natural and artificial lighting equipment deteriorates very rapidly unless properly maintained. In every factory there should be a regular and definite system of maintenance, providing for the cleaning and repair of glass areas, lamps and reflectors, and replacement of burned-out lamps. Walls, ceilings and other reflecting surfaces, including equipment, should be repainted regularly.

Hangers are made which permit lighting units to be disconnected both mechanically and electrically. By simply pulling a rope, they are lowered to the floor, where they may be quickly and thoroughly cleaned. This arrangement eliminates much hazardous work over equipment and in proximity to moving shafts and belting, interference with workmen, blocking of aisles with ladders and the distraction of employees from their tasks.

Bettering lighting conditions is often simply a matter of adequate maintenance of existing equipment rather than calling for radical changes in installations, or the addition of lighting units. See Fig. 1.[2] Ignorance of the depreciation is often the cause of neglect. It is well to know that from 40 to 60 per cent of the money paid for light may be wasted through lack of cleaning and upkeep, while all the benefits of good lighting are lost.

In designing lighting systems full allowance must be made for depreciation of lamps, unavoidable dust and dirt on reflectors, walls, ceilings and other reflecting surfaces, and care taken that current of the proper voltage for the lamps is supplied. The average light output of Mazda lamps for a rated life of 1000 hr. is 94 per cent. The losses due to dirty lighting units are indicated in Fig. 2,[3] while those due to supplying current of improper voltage will be about as follows: A socket voltage 5 per cent low means a light loss of 17 per cent; 10 per cent low, 31 per cent; while an overvoltage of 5 per cent will reduce the life of the lamp 45 per cent, and a 10 per cent overvoltage as much as 75 per cent.

At the Ferro Machine and Foundry Company, where but little attempt had ever been made to keep the windows clean, a thorough scrubbing increased the illumination from 3 ft.-candles to 11 ft.-candles, a gain of 266 per cent. Another workshop with a large glass area showed a gain in light intensity from 0.7 to 15 ft.-candles by cleaning the windows inside and out.[4] These examples are typical of conditions permitted to prevail simply through lack of appreciation and attention.

Daylighting Factories

With 80 to 90 per cent of glass in wall areas, buildings 60 ft. in width may be daylighted.[5] With side

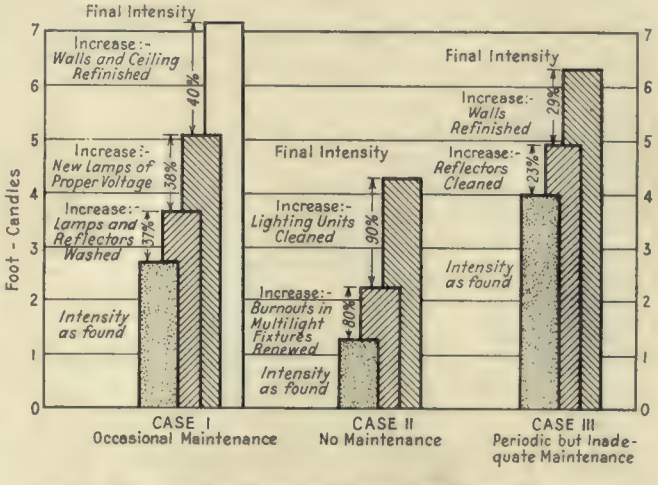


FIG. 1 EFFECTS OF CLEANING EQUIPMENT AND RENEWING LAMPS

Tests on semi-indirect and indirect lighting systems.

walls 100 per cent glass (special reinforced concrete and steel construction), or by using prism glass, this width may be much increased. The plant of the E. W. Bliss Company, Hastings, Michigan (formerly Consolidated Press Company), provides a good example of the utilization of daylight in carrying on machine shop operations. See Fig. 3. Practically the entire

[1] See MANAGEMENT IN MANUFACTURING, November 1925, pp. 277-280, for a previous article on "How Good Lighting Benefits the Shop," by A. G. Anderson.

[2] "Code of Lighting," p. 11, Illuminating Engineering Society, New York.

[3] From Instruction Book (30315), Cooper Hewitt Electric Company.

[4] See *Factory*, September 1923, pp. 312-315, "Bringing Daylight Into Your Present Building," by W. T. Spivey.

[5] For the best lighting the height to top of glass in windows should not be less than one-half the depth of the room (windows on one side), and the glass area should be at least one-fifth of the floor area. Pilasters or mullions should be limited to one-quarter the width of the glass area between them.

side wall is a window, 30 by 280 ft. opening into the machine bay.

Clear glass should be used in windows a foot or so above eye level to permit employees to relax and rest the eyes occasionally by gazing into the distance. More production results. Also, obscure glass cuts off needed light. There are various kinds of diffusing and prism glass, but all are not entirely successful, owing to the inevitable accumulation of dust and dirt on irregular surfaces, the tendency to cause glare, and the loss of light. Ribbed glass with ribs set vertically serves to direct rays into the interior and is one of the most satisfactory forms.

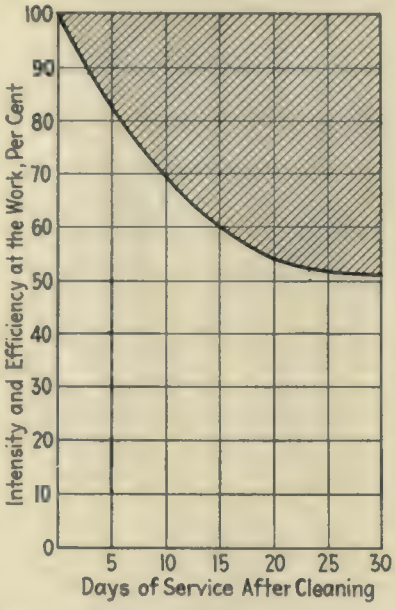


FIG. 2 EFFECT OF DIRT ON LIGHTING UNITS

Ceiling designs are also a factor. Flat slab concrete construction provides a flat ceiling which is ideal for light reflection. When beams and girders are used they should be placed, if practicable, at right angles to the windows so as not to obstruct the light. The elimination of overhead shafting and belt drives, forethought in the placing of machinery, care in the storage of materials, the use of wire partitions, and proper painting of surfaces contribute to the best utilization of the available light.

Foundries, forge shops and other branches of the metal trades industry find it necessary to utilize special roof constructions. These comprise Pond trusses, A-frames, skylights, saw-tooths and monitors. They are a big factor in obtaining light. The top floors of multi-story buildings may be better lighted by adopting some form of roof lighting to supplement that from side wall sash.

Unsatisfactory natural lighting may be due to one or more of the following causes: (1) Old and unsuitable buildings; (2) obstruction of light by exterior surroundings; (3) dirty glass areas; (4) failure to clean or paint walls and ceilings; (5) obstructions of light by equipment, materials or solid partitions; (6) failure to utilize roof areas to advantage, etc.

Cost of Lighting

The money cost of supplying light per individual workman is likely to be over-estimated. The difference in relative cost of labor and light in the factory is very great. Assuming that each workman utilizes the light from one 100-watt unit, two hours each day, 300 days a year, the figures in the following table are approximately correct:

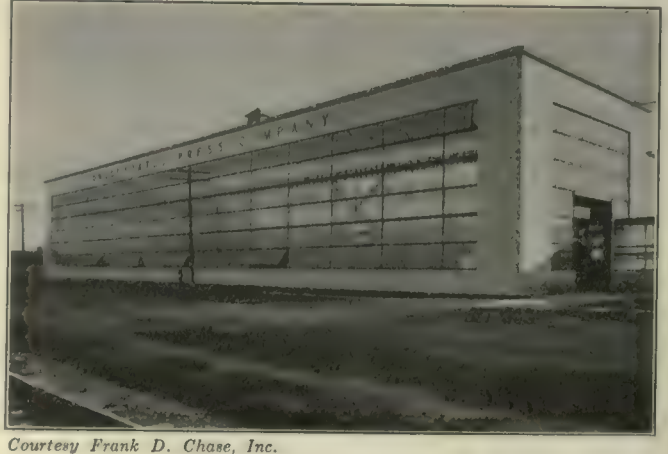
Investment:	
Cost of lamp, reflector and wiring per outlet	$12.00
Operating expense:	
Interest, taxes and insurance, 10 per cent.	1.20
Depreciation on reflector and wiring, 12½ per cent.	1.40
Renewal of lamp	0.60
Cleaning 24 times a year at $0.04 per cleaning	0.96
Energy at $0.05 per kw. hr.	3.00
Total annual operating cost	$7.16
Annual wages of workman:	
Eight hr. per day at $0.50; 8 × 300 × $0.50	$1200.00

The daily operating cost is but $0.024: the workman's wages for but three minutes equals this; so that any increased production or improvement of quality to the extent of this amount will pay the cost.

Daylight may cost as much or more than electric light. Account must be taken of heat losses through glass areas, increased cost of windows and roof constructions, upkeep, interest and depreciation, and of the space occupied by light courts.

Systems of Illumination

The three general systems of illumination in the order of their efficiency are known as the (1) direct, (2) semi-indirect, and (3) indirect systems. In the former the reflectors distribute the light downward to the working surfaces; in the latter, all of the light is directed toward the ceiling and from there reflected downward. In the semi-indirect system, part of the light is directed toward the ceiling, but some of the rays pass through the enclosing bowl to the working surfaces. Some types of fixtures are equipped with reflectors which transmit some of the rays to the ceiling, but reflect the greater share downward. General overhead light, or "room lighting," may be accomplished with any of the systems. "Job lighting," or local lighting of needed higher intensities than general room lighting may be accomplished readily by supplementary direct lighting units placed close to the work.



Courtesy Frank D. Chase, Inc.

FIG. 3 A DAYLIGHT FACTORY OF THE E. W. BLISS COMPANY

Direct lighting systems employ reflectors to improve the distribution of the light, diffuse the direct rays from the lamp and increase the apparent size of the source. They are least affected by dust and dirt, are not dependent upon wall and ceiling reflecting surfaces, and are the most economical to install and operate, as little light is wasted, or lost by absorption. With direct lighting care must be taken to avoid glare, objectionable shadows and too great light contrasts. The RLM standard dome reflectors,[6] are used widely for direct lighting in factories, either with a bowl-enameled lamp (see Fig. 4), or with an opal glass diffusing globe enclosing the lamp to decrease the brightness and minimize glare, and a glassteel diffuser to distribute some light to the walls and ceiling.

Courtesy Westinghouse Lamp Co.

FIG. 4 CARPENTER SHOP OF WESTINGHOUSE LAMP COMPANY, BLOOMFIELD, NEW JERSEY, PLANT

Westinghouse-Cutter RLM reflectors with 150-watt Mazda C, bowl-enameled lamps are installed. Spacing 10 x 10 ft. Height 9 ft. 6 in. above floor.

In indirect lighting the ceilings and walls are utilized for the redirection and diffusion of all the light emitted by the units. With the entire ceiling acting as a light source glare is reduced to a minimum and shadows are eliminated, but the illumination of other than horizontal planes is more difficult. Naturally the cost of operation is greater because of the light lost by absorption and the greater effect of dust accumulations on this type of fixture. Where vapors or fumes are present, or the colors of materials worked upon absorb light readily, or reflecting surfaces are lacking, the system will not prove practical. For tasks which require the perception of three dimensions, shadows are needed, especially when the contrast between the object and its background is slight, as in type-setting. Direct lighting is best for work of this kind. However, for close work indirect light is much easier on the eyes than any other form of lighting, and where it can be used its advantages will be appreciated. Perfect illumination is afforded by the indirect rays of the sun filtered through clouds, a natural indirect light.

Semi-indirect lighting offers a combination of the other systems with a modification of their disadvantages. The amount of direct light may be controlled by varying the density of the glass reflectors. Oblique and vertical surfaces are better illuminated and the cost of operation is less than with indirect lighting, while from the glare and shadow standpoints the system is an improvement over direct lighting.

Mercury vapor lamps have been used with good results in a large number of automobile body finishing departments. One such installation at the plant of the Fisher Body Company, Detroit, brought about large savings. Working time in this department was reduced from 58 to 48 hr. a week following the installation of Cooper-Hewitt lamps, without any decrease in production. The saving in overtime effected amounted to $400 a week, over $20,000 a year.

Fig. 5 shows a typical installation of Cooper-Hewitt

Courtesy Cooper-Hewitt Electric Co.

FIG. 5 MERCURY VAPOR LAMPS IN FINISHING DEPARTMENT FOR PACKARD BODIES

[6] A standard product manufactured by various reflector and lamp manufacturers according to rigid specifications.

mercury vapor lamps in a finishing department turning out Packard bodies.

Lighting units should be selected in accordance with their rating from the standpoint of greatest adaptation to the work to be illuminated. A usual method employed by manufacturers to rate units is based on the following factors: (1) Illumination on horizontal surfaces; (2) illumination on vertical surfaces; (3) favorable appearance of room; (4) direct glare; (5) reflected glare; (6) shadows; and (7) maintenance. The unit which grades highest in most of the factors important in any particular installation is the one to select.

Design of a Lighting System

The four steps to be carried out in the design of a general lighting system for a room are:

1. Decide the foot-candle illumination required.
2. Select the type of lighting unit best adapted to the location.
3. Determine the location of outlets, the mounting height and number of units required.
4. Ascertain the size of lamp which will provide the foot-candles desired.

Desirable intensities of illumination depend on the accuracy of the operation and fineness of detail to be observed, the color of goods worked on, or handled, etc.

The selection of reflecting equipment will vary with the character of the work, the presence or absence of reflecting surfaces and obstructions to the distribution of the light, the position of the working planes, and the necessary placing of the light sources.

In determining upon the number of lamps to be used and their location it is well to make a plan to scale of the area to be lighted. Divide it into squares, considering columns, ceiling beams, height of ceiling, obstructions to light distribution and objection to shadows, in order to get a typical unit of area. Higher ceilings permit a wider spacing of units, with the use of a fewer number of larger size, which is preferable from an installation and operation standpoint. Shadows will be increased, however. If less than 10 ft. high, lamps come too much within the range of vision and cause glare.

Following the location of outlets on the plan, lamp sizes may be determined as follows:[7]

$$\text{A. Area in sq. ft. per outlet} = \frac{\text{Total floor area in sq. ft.}}{\text{Number of outlets}}$$

$$\text{B. Lamp lumens required per sq. ft.} = \frac{\text{Ft.-candles} \times \text{Depreciation factor}}{\text{Coefficient of utilization}}$$

$$\text{C. Lamp lumens required per outlet} = [\text{Area in sq. ft. per outlet (from A)}] \times [\text{Lamp lumens required per sq. ft. (from B)}]$$

For fairly clean locations a depreciation factor of 1.3 may be used; for more dirty locations, or places where cleaning will be infrequent, 1.5. The coefficient of utilization is taken from prepared tables and is dependent upon the size and proportions of the room, the type of fixtures and the color of the walls and ceiling. It represents the proportion of the light from the lamps which reaches the plane of work. Mazda lamps are rated in lumens so that the size of lamps may be readily chosen.

[7] "Illumination Design Data," Bull. No. 41-A, p. 5, National Lamp Works of the General Electric Company.

Planning a Specific Lighting Installation[8]

The floor plan of the space to be lighted will be assumed as 80 ft. by 120 ft., with a distance of 12 ft. to the bottom of the saw-tooth roof construction. The upper walls are painted a medium light color. The area is a machine shop.

1. Ft.-Candle Illumination: The intensity of illumination desired on the working plane is 9 ft.-candles.
2. Type of Lighting Unit: The RLM dome with bowl-enameled lamp is selected, based on efficiency and favorable showing from the standpoints of glare, reflected glare, shadows and maintenance.
3. Location of Outlets, Mounting Height and Number of Units: Allowing 1 ft. 6 in. for drop, the maximum mounting height above the floor is 10 ft. 6 in. The height of the plane of work is 3 ft. 6 in.; thus the mounting height is 7 ft.

   From Table of Spacing—Mounting Height, in manufacturer's manual, this distance permits a distance between outlets of 10 ft. 5 in., with a spacing from the wall of 5 ft.

   From the assumed dimensions of the room it is apparent that a symmetrical spacing of units 10 ft. apart, with a distance of 5 ft. between outside row and wall is satisfactory, and we will adopt it.
4. Lamp Size: Substituting our data in equations A, B and C, given above, we have the following:

$$\text{A. Area in sq. ft. per outlet} = \frac{\text{Total floor area in sq. ft.}}{\text{Number of outlets in room}} = \frac{9600}{96} = 100$$

$$\text{B. Lamp lumens required per sq. ft.} = \frac{\text{Ft.-candles} \times \text{Depreciation factor}}{\text{Coefficient of utilization}} = \frac{9 \times 1.4}{0.60} = 21$$

A depreciation factor of 1.4 is arbitrarily chosen.

The coefficient of utilization is determined by selecting the proper room index from the table in the manufacturer's manual. Referring to the table of RLM dome bowl-enameled lamps, also in the manual, in a location with a room index of 5, and where the ceiling and walls are fairly light, the coefficient of utilization is found to be 0.60.

Combining A and B we have:

C. Lamp lumens required per outlet = [Area in sq. ft. per outlet] × [Lamp lumens required per sq. ft.] = 100 × 21 = 2100

From the lamp table in the manual, a 150-watt Mazda C lamp giving 2100 lumens is found to satisfy the requirements.

[8] Excellent tables and data supplying detailed information on the factors entering into a lighting installation, and giving definite values to be used in calculations and in selecting equipment, can be obtained from any of the manufacturers of factory lighting equipment. Those used here are from the Illumination Design Bulletin of the General Electric Company. Values for ft.-candles of illumination required in a wide variety of manufacturing processes are given also in "Management's Handbook," pp. 334-337.

Known Costs Bring Greater Profit

Management in Southern Furniture Plants

By CHARLES F. SCRIBNER

Management Engineer

SELLING prices for the product of furniture factories are, to a large extent, fixed by competition. The products are shown at the furniture exhibitions and orders are booked at stated prices, before the goods have been completed at the factory and actual cost figures obtained.[1]

So, while the actual cost of the product does not serve as the basis for fixing selling prices for that product, it does determine the margin of profit which is to be secured. Under these conditions a knowledge of costs on styles and patterns previously made is essential, so as to establish standard costs for new styles and patterns and to insure selling prices that will net a profit from the business taken.

Various branches of the furniture manufacturing industry have from time to time adopted uniform cost finding plans. Such plans are generally introduced, first, by association members who have served on the cost committee, then by the larger and more progressive firms in the industry. Too often the small and medium-sized plant does not become interested in the subject at all.

The objections on the part of the smaller concerns to introducing better cost methods are found in one or more of the following:

1. They see their nearest competitors getting along and apparently making money without cost methods.
2. They are more interested in increasing prices than in reducing costs when satisfactory profits are not secured.
3. Factory executives object that new methods will require too much of their time; the real reason being their fear that the management will secure all the facts about operating conditions.

Purpose of Cost Finding

The real purposes of cost finding in furniture manufacturing are:

1. To furnish data and definite standards by which administrative and production activities may be measured and directed.
2. To furnish data for the purchasing and sales departments by which their activities may be profitably conducted.

The proof of such data and information as is furnished must be shown through co-ordination of the cost finding methods with the general accounting system.

For clearly showing the divisions of the cost function as applied to furniture plants, a most satisfactory outline is shown in the chart, Fig. 1.[2] Its purpose is to present a uniform practice which will be followed in all plants, rather than a theoretical arrangement of the factors involved. In some plants certain of the items given are not required; in others, additional items will have to be used. This outline indicates where omissions can be made and where additional items should be shown.

Standard Costs for Estimates

When a new line of furniture is prepared for exhibition the samples are made up and finished and an estimated cost of the new products is made up, following the form shown in Table 1.

These figures are taken to the exhibition and before price tags are attached to the various articles an attempt is made to find out the prices at which competing lines are to be sold. If such prices are secured, price tags are made up with prices at which it is believed the goods can be moved in considerable volume. When it is found necessary to adjust the prices, some items are increased to take care of the reduction made on other items, so that on the whole suite a satisfactory profit is returned.

Where a satisfactory volume of business is not secured at the exhibitions many manufacturers revise their price lists after the close of the expositions and before their salesmen take the road to call on their trade. This occurs especially if mistakes have been made in prices or when lumber and mirrors, which are major items in furniture cost, are being advanced in price due to buying activity.

That plant which has no costs upon which to rely makes no attempt to set up a detailed estimated cost, depending upon learning what the other fellow is doing when the market opens, then setting its prices accordingly, on the assumption, "If he can make it for that, so can I." In more than one instance such practices have led to serious financial difficulties.

In treating labor cost in furniture factories there is a condition to be met which does not exist in industries where the production order serves as the basis

[1] Preceding articles appeared in MANAGEMENT IN MANUFACTURING, June 1925, pp. 521-524; August 1925, pp. 83-86; September 1925, pp. 145-148; October 1925, pp. 217-220; November 1925, pp. 267-270.

[2] From "Standard Costing Principles and Practices for the Plywood Industry," prepared by H. D. Potter for the Plywood Manufacturers Association.

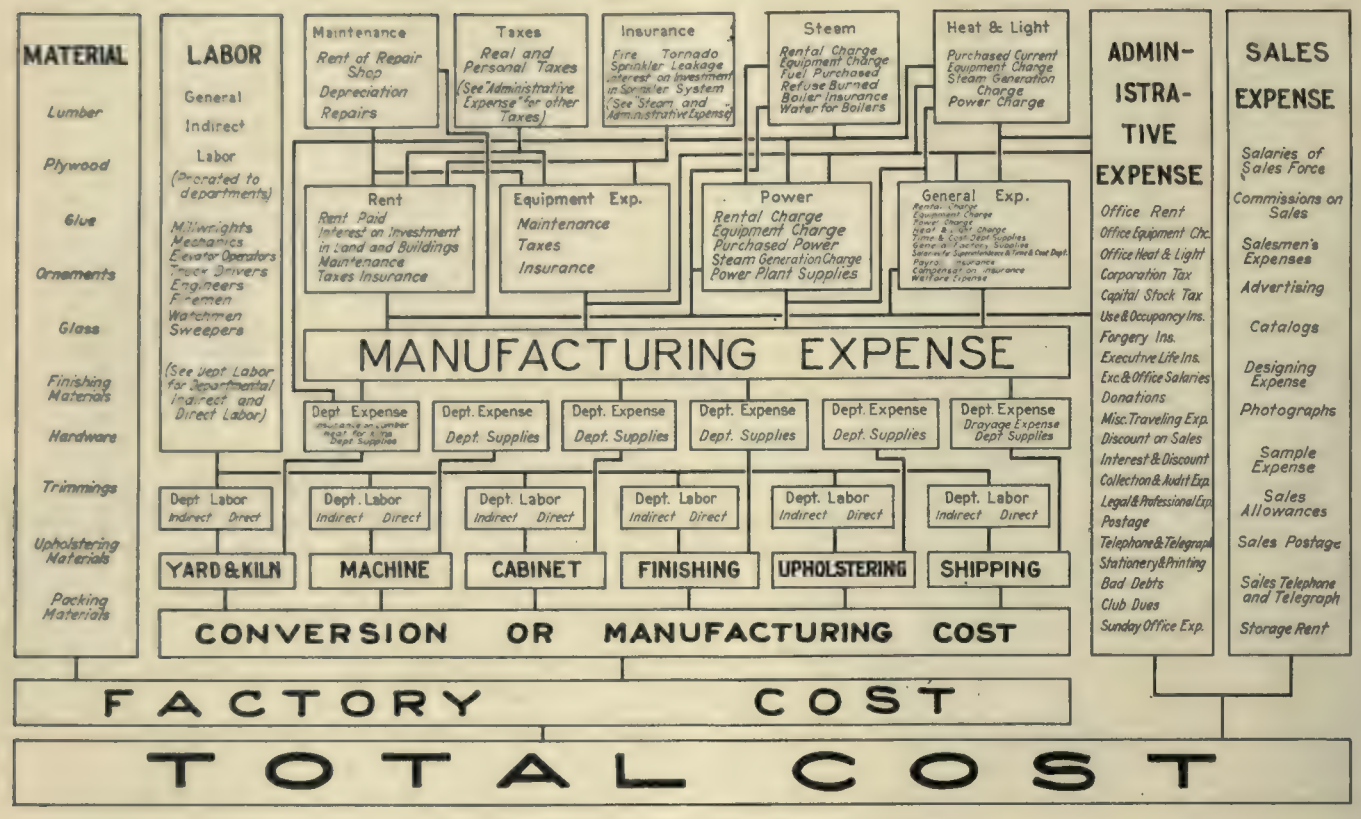


FIG. 1 DIVISIONS OF COST IN FURNITURE PLANTS

for withdrawal of raw material and all labor which is spent on the order until final completion. In the yard and dry kiln, for instance, the labor spent is applied to material which is used on several different orders. Again, in the cutting-up operation, it may be that the operator and his helper are working on two or more orders at the same time so as to keep lumber waste at a minimum. These conditions make it impossible to report the time spent on specific orders accurately for certain operations, so a distribution of this time must be arranged for. It has been found best to treat this labor as "indirect," rather than to permit a portion of it to go into factory expense or overhead.

Direct labor is, of course, accumulated by charges directly to the orders being worked upon and is shown through Job Order Time Cards.

In Table 2 is shown an analysis of indirect labor and its comparison with direct labor in a furniture manufacturing plant. This analysis is prepared by the accounting department of the plant in question at the close of each month and furnishes the basis upon which the management directs the attention of the several foremen to a betterment of conditions in their departments during the next month.

From the fact that the value of materials used in furniture manufacture constitutes an important element of cost, its careful determination is essential. As to methods by which material is charged, there are almost as many as there are plants. The greatest amount of trouble and the most serious error in costs arises from the use of a uniform percentage of waste, which has been set from some previous tests and which does not represent accurately what is occurring on current orders. Unfortunately, this is common practice.

Table 3 shows the variation in waste of lumber when cutting various orders in the machine room. The average percentage of waste is 39.4 per cent, ranging from 22 to 60. When this average figure is used in cost calculations it will be seen that serious errors are sure to result on those orders where the actual waste is considerably less.

A satisfactory control of lumber costs has been secured by tallying in the lumber to be cut against a small group or lot of orders which use the same material, then distributing the total against the individual orders in proportion to net requirements, prorating the balance according to the net amounts in each case. While this gives an average waste figure, it does so on a small lot of orders using the same material, and it absorbs all of the charges for material actually used, as well as preserving records of stock on hand. The relative importance of labor and material costs is shown in Table 1.

Factory Expense Costs

Some furniture manufacturers cling to the method of charging a uniform expense or burden rate to all departments; many have adopted a variable expense rate for different departments. The first practice tends to cover up leaks and wastes which should be brought to light and is positively dangerous.

For, example, take the manufacture of upholstered furniture. This is made almost entirely by hand and does not require as high a rate of expense as bedroom or dining room furniture, which necessitates expensive

TABLE 1. ESTIMATED COSTS ON BEDROOM FURNITURE

No. 270 Dresser, 48-in. Walnut and Mahogany Finish

			Per 100 Units
Material			
Lumber			
Sap gum 4/4	3889.29 ft. @ $45.00		$ 175.01
8/4	1558.78 ft. @ $55.00		85.73
Laminated stock			550.00
Fittings			33.00
Casters			7.90
Mirror backs			14.00
Mirrors (28 in. x 32 in.)			1,055.00
Labor			
Machine Department	2.65 hr. @ $0.372	$97.46	
Cabinet Department	2.91 hr. @ 0.331	96.32	
Finishing Department	2.07 hr. @ 0.35	72.45	266.23
Factory Expense			
Based upon direct labor employed			532.46
Factory cost			$2,719.33
$27.19 + 40% Administrative expense		= $38.06	
$38.06 + 20% Sales expense		= $45.67	

No. 270 Dresser, 48-in. Ivory Finish

			Per 100 Units
Material			
Lumber			
Sap gum 4/4	3889.29 ft. @ $45.00		$ 175.01
8/4	1558.78 ft. @ $55.00		85.73
Laminated stock			474.00
Fittings			33.00
Casters			7.90
Mirror backs			14.00
Mirrors (28 in. x 32 in.)			1,055.00
Labor			
Machine Department	2.65 hr. @ $0.372	$97.46	
Cabinet Department	2.91 hr. @ 0.331	96.32	
Finishing Department	2.07 hr. @ 0.35	72.45	266.23
Factory Expense			
Based upon direct labor employed			532.46
Factory cost			$2,643.33
$26.43 + 40% Administrative expense		= $37.00	
$37.00 + 20% Sales expense		= $44.40	

machinery and equipment. Yet a number of plants producing all three lines charge a uniform rate throughout.

One progressive firm, making a wide variety, finds that its department expense rates range all the way from 45 to 130 per cent on direct labor, while another concern uses rates ranging from 37 to 186 per cent. From this it is seen that a firm making a wide variety of finished product and using a uniform expense rate throughout all departments will be costing one line too low—getting a lot of unprofitable business—and another line too high—getting very little profitable business. At the end of the year the manager has to explain the "riddle" to his board of directors as best he can.

It is common practice in this industry to distribute factory expense as a percentage of direct labor. Many times this is decidedly unfair.

Administrative and Selling Expense

In many furniture plants it is the practice to distribute administrative and sales expense on the basis of production cost. As long as the volume of sales and volume of production keep at about the same level, making a high turnover and a low inventory of finished stock, this practice has been satisfactory.

During the past few years there has been an increasing tendency on the part of buyers to refrain from making large individual purchases and warehousing the goods near their retail locations. This has resulted in manufacturers having to increase their inventories of finished goods and means that administrative and sales expense can best be distributed on the basis of net sales instead of on production.

As most of the items which comprise these expenses

TABLE 2. COMPARATIVE ANALYSIS OF LABOR CHARGES

General Indirect Labor	Analysis of Labor Charges																					
	Monthly		Yard and Kiln			Machine Dept.			Cabinet Dept.			Finishing Dept.			Upholstering Dept.			Shipping Dept.		
	Hrs.	Wages	Per Cent	Hrs.	Wages	Per Cent	Hours	Wages	Per Cent	Hours	Wages	Per Cent	Hours	Wages	Per Cent	Hours	Wages	Per Cent	Hours	Wages
1 Watchman	368	$ 86.80	10	36.8	$ 8.68	12	44.2	$ 10.42	13	47.9	$ 11.28	25	92.0	$ 21.70	25	92.0	$ 21.70	15	55.2	$ 13.02
2 Machinists	477	238.50				70	333.9	166.95	10	47.7	23.85	10	47.7	23.85	10	47.7	23.85			
1 Carpenter	238	111.86	20	57.6	22.37	50	119.0	55.93	10	23.8	11.19	5	11.9	5.59	10	23.8	11.19	5	11.9	5.59
1 Saw Filer	238	95.20				95	226.1	90.44							2	5.8	1.90	3	7.1	2.86
1 Oiler	238	76.16				80	190.4	60.93	5	11.9	3.81	5	11.9	3.81	5	11.9	3.81	5	11.9	3.81
1 Yard Foreman	238	111.86	100	238.0	111.86															
1 Truckman	238	93.30	30	71.4	28.00	5	11.9	4.67	5	11.9	4.67	5	11.9	4.67	5	11.9	4.67	50	119.0	46.65
7 Laborers	1,666	499.80	20	333.2	99.96	20	333.2	99.96	15	249.9	74.85	10	166.6	49.98	10	166.6	49.98	25	416.5	124.95
1 Fireman	260	83.20	12	31.2	9.98	25	66.0	20.80	15	39.0	12.48	23	59.8	19.14	15	39.0	12.48	10	26.0	8.32
1 Engineer	260	104.00	12	31.2	12.48	25	66.0	26.00	15	39.0	15.60	23	59.8	23.92	15	39.0	15.60	10	26.0	10.40
12 Employees	4,221	$1,500.68		799.4	$293.33		1,390.7	$536.10		471.1	$157.73		461.6	$152.66		437.7	$145.18		673.6	$215.60
Departmental Indirect Labor			No.	Hrs.	Wages	No.	Hours	Wages	No.	Hours	Wages	No.	Hours	Wages	No.	Hours	Wages	No.	Hours	Wages
5 Foremen						1	238	$ 200.00	1	238	$ 175.00	1	238	$ 180.00	1	238	$ 160.00	1	238	$ 170.00
4 Asst. Foremen						2	476	300.00	1	238	150.00	1	238	130.00						
3 Dispatch Clerks						1	238	100.00	½	119	40.00	½	119	40.00	½	119	40.00	½	119	40.00
6 Inspectors						2	476	225 00	1	238	95.00	1	238	80.00	1	238	75.00	1	238	95.00
1 Knife Grinder						1	238	90.00												
1 Storekeeper															1	238	95 20			
4 Dept. Truckers						2	476	142.60	1	238	71.40	1	238	71.40						
3 Sweepers						1	238	64 26	½	119	32.13	½	119	32.13	½	119	32.13	½	119	32 13
1 Elevator Man						1	238	64.26												
1 Glue Mixer						1	238	95.20												
29 Employees						12	2,846	$1,281 32	5	1,190	$ 565.53	5	1,190	$ 533.53	4	952	$ 402.33	8	714	$ 337 13
Total Indirect Labor 41 Employees				799 4	$293 33		4,236.7	$1,717.42		1,661.1	$ 723.26		1,651.6	$ 686.19		1,389.7	$ 547.51		1,387.6	$ 552.73
Direct Labor 248 Employees						80	19,040	$7,616.00	42	9,996	$3,698.52	50	11,900	$4.284 00	40	9,520	$3,617.60	36	8,568	$2,998.80
Total Labor 289 Employees				799.4	$293.33		23,276.7	$9,333.42		11,657.1	$4,421.78		13,551.6	$4,970.19		10,909.7	$4,175.11		9,955.6	$3,551.53
Indirect to Direct							22.2%	22.5%		16.7%	19.5%		13.9%	16.0%		14.6%	15.2%		16.2%	18 4%
Average Rate per Hour					$0.368			$0.40			$0.39			$0.368			$0.382			$0.356

vary in relation to sales, this change has not only been of benefit to the industry, but to the individual manufacturer as well.

TABLE 3. LUMBER WASTE PERCENTAGE IN PROPORTION TO NET QUANTITY REQUIRED

Wood	Grade	Thickness	Waste, Per cent of Net Required
Sap gum	1st and 2nd	4/4	35
Sap gum	1st and 2nd	4/4	38
Sap gum	No. 1–2 Com.	4/4	46
Sap gum	No. 1–2 Com.	4/4	44
Sap gum	1st and 2nd	6/4	37
Sap gum	No. 1–2 Com.	6/4	48
Sap gum	No. 1 Com.	6/5	43
Red gum	1st and 2nd	4/4	32
Red gum	1st and 2nd	4/4	34
Red gum	No. 1–2 Com.	4/4	45
Red gum	No. 1 Com.	8/4	43
Chestnut	No. 1–2 Com.	4/4	36
Chestnut	No. 1–2 Com.	4/4	38
Chestnut	No. 2 Com.	4/4	41
Chestnut	No. 2 Com.	4/4	44
Poplar	No. 1–2 Com.	4/4	22
Poplar	No. 1–2 Com.	4/4	31
Poplar	No. 2 Com.	4/4	37
Poplar	No. 2 Com.	4/4	34
Plain oak	No. 1 Com.	4/4	40
Plain oak	No. 1 Com.	4/4	42
Plain oak	No. 1 Com.	5/4	38
Plain oak	No. 2 Com.	6/4	47
Quartered oak	1st and 2nd	4/4	32
Quartered oak	No. 1 Com.	4/4	48
Quartered oak	No. 2 Com.	4/4	60

By far the larger portion of furniture sold by manufacturers is sold by salesmen who are paid a straight commission, an analysis of the amount of this commission, made in 1924, showing that the average paid by a large number of firms was 7½ per cent. This, added to the cost of samples and exhibition expense, constitutes the major part of selling expense.

Of the three methods used in paying salesmen: (a) commission, (b) salary, and (c) salary and bonus, it is surprising that so many firms adhere to the commission plan when there are so many arguments in favor of more advanced methods.

The writer recognizes the hesitancy with which management approaches any change of relations with its selling organization, at the same time those concerns who have adopted the salary and bonus plan of paying their salesmen would, under no consideration, return to the commission plan.

When a concern is building for the future and wants customers that are their own; when they want business that is not handicapped by high freight rates, they will build their business most quickly by paying a moderate salary and a liberal bonus to their salesmen, as some of the representative and most profitable furniture manufacturers have done during the past few years.

Reports for Managerial Control

As costs are furnished to department foremen they usually relate to specific orders. In this form they are of little or no value for improving conditions. Generally, they are furnished too long after the job is completed and there are too many of them to be properly analyzed, so the foremen put them aside and end by forgetting them entirely.

It is only by presenting costs in total and comparing them with pre-determined standards that the interest of foremen can be secured in making cost reductions. When such information is regularly furnished the foremen they quickly become department managers, directing the affairs of their departments in a better and more profitable way than ever before. The fear of some managers, that cost figures given to foremen are liable to leak to outside concerns, is groundless. Experience proves that this is seldom the case and even were it true, conditions in no two plants are so near alike as to make the information of much value to a competitor.

In conclusion the writer points out that where an analysis has been made of causes and their effects, a definite planning for results and a practical working of the plans when made, there has been a decided increase in the profitableness of operation, as has been the case in other industries. What those have secured who have introduced sound methods of modern management, others can secure. Constant attention must be given, however, to guard against mistaking "system" for management methods and to believing that cost and operating records can serve more than as a means to a better end.

Economical Truck Battery Charging

AN interesting arrangement of battery charging equipment, obviating the necessity of purchasing an additional motor generator, was recently made by a western company using a number of storage battery trucks. A 125-volt, multiple battery charging motor-generator was being used, the capacity of which was seven trucks charging at a 40-amp. rate. It was found necessary to double the number of trucks and, at first, it seemed necessary to install a duplicate charging equipment.

Upon conferring with the San Francisco office of the General Electric Company, however, an arrangement was devised whereby the starting time of batteries was staggered. Those which had been charging for some time would gradually require less and less current, and additional batteries could be added, in turn, for charging. The equipment used for the purpose was a solenoid operated dial switch actuated by means of a contact-making ammeter. The ammeter rotated the dial switch to increase or decrease the number of batteries connected on the terminals when generator amperage varied between predetermined limits.

Ampere-hour meters with auxiliary contacts to disconnect the battery when charged were also installed, together with a plugging system to permit charging of trucks in any desired order, push-button stations to permit connecting any desired battery to the line without automatic operation, a reset switch, etc.

By this arrangement, a consistently high load factor is maintained on the generator. The amount of installed capacity, and attention required by operators were also reduced to a minimum.

Methods of Protecting Shipments

Practical Points on Packing That Are Often Overlooked

By C. A. PLASKETT

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MANUFACTURERS and shippers in general recognize the benefits which are to be derived from properly packing their goods for shipment, yet but few have attained ideal success. They appreciate the fact that it is equally wasteful to pack too solidly as to pack inadequately. The problem that still puzzles the majority is how to avoid loss and damage in transit without excessive packing costs.

To solve it there are two distinct phases which must be considered: First, the design of the container itself,

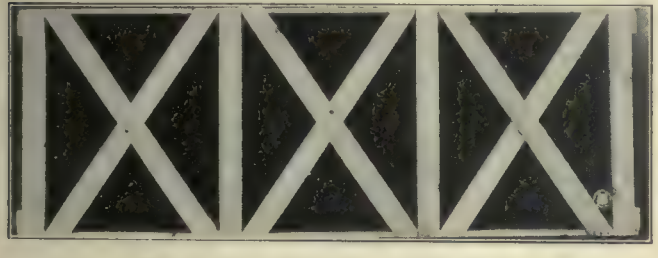

FIG. 1 SIDE VIEW OF A LONG CRATE

This shows the method of increasing resistance to bending by using several sets of cross bracing and cross members.

and, second, the internal packing or method of supporting the contents. The two are equally important and are, of course, interdependent.

A container even of very heavy construction may prove insufficiently strong if the contents are not properly supported, whereas a lighter container with less strength may prove satisfactory if the contents are packed so as to bring the stresses to the parts of the container and contents best able to withstand them. Again, the container may be amply strong to withstand the hazards of transportation and yet the contents may be badly damaged because of improper packing or lack of the proper kind of protection. No amount of good container design will compensate for faulty packing, or vice versa.

If the product is itself strong enough to withstand the hazards of transportation, then all that may be required is merely a snugly-fitting container to protect it from the blows and make it stack well. On the other hand, the product may be easily damaged by distortion or by rubbing of polished surfaces. Such products require a container that has a high resistance to skewing or distorting, or else they must be so packed that the container when distorted will not come into contact with them. Again, the product may be able to distort considerably without damage and absorb shocks, or it may require some cushioning material to protect it from shocks.

The first question, therefore, is to determine the kind of protection required and whether the contents have any strength to lend to the container. Consideration should then be given to selecting the particular type and design of container—crate, box, barrel, or basket—which is best suited to the product. Whatever container is selected, it should be built strong enough to meet general requirements for the particular method of transportation and yet of such materials and so put together as not to be unduly heavy or of too great volume. In other words, the container should be designed to have a high ratio of load to total weight and volume. This is important not only from the standpoint of saving materials but because dead weight and excess volume of the container are factors in freight and storage charges.

Much space may be saved by shipping machines of irregular shape in knocked-down condition or by fitting two or more machines with one large container. The cost of dismantling and packing, and the cost and inconvenience of assembling the product at its destination, often by those not familiar with the product, should, of course, be balanced against the cost of

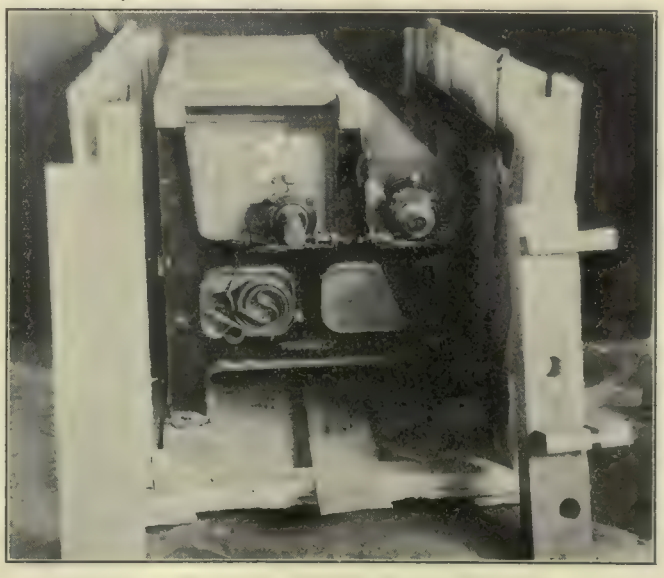

FIG. 2 RECOMMENDED METHOD OF PACKING COTTON GIN

Appearance before end blocking is put in place.

shipping the product in a completely assembled form.

No detail of design or method of packing can be overlooked. In crating articles requiring protection against distortion, such as furniture or delicately adjusted machines, the crate must be very rigid or of such size that it can distort considerably without coming in contact with the contents. Usually it is more economical to use a rigid crate than to build it too large. Diagonal braces are the most effective means of producing rigidity. As a rule, double or cross bracing (two braces on each face) produces greater rigidity than single diagonal bracing, but usually a single brace on each face is ample. The direction of wood braces on opposite faces of the crate is of little consequence. To be effective, single braces must be capable of acting in either tension or compression. Regardless of the direction in which they are placed on the crate they are likely to be stressed in either manner, according to the corner on which the crate happens to be dropped. In any case, the braces should be placed as nearly as possible at an angle of 45 deg. with the edge members. For this reason long crates should be divided into approximately square panels by cross members and each panel braced with one or two braces to form a truss, as in Fig. 1.

The number of crate faces which should be braced to obtain maximum rigidity depends somewhat upon the commodity packed in the crate. Diagonal braces on two opposite faces produce rigidity in one direction only, on four opposite faces in two, and on all six faces in all three directions. An odd number of braces, or braces on adjacent faces without the opposite sides being braced, will cause the crate to twist when dropped on a corner. For instance, if five sides of the crate are braced and the sixth side left unbraced by the contents or otherwise, a drop on a corner will cause the unbraced side to distort diagonally. Since the other five sides are braced against distorting diagonally, the stresses induced in them by distortion of the unbraced side causes them to twist out of a plane, which in turn causes the whole crate to twist spirally. If the commodity is securely fastened to the unbraced side of the crate and is strong enough of itself to act as a brace for that side, then no distortion or twisting will occur. If in addition to resisting distortion the commodity is rigid enough to resist twisting, the bracing may be omitted from one other side of the crate without causing distortion.

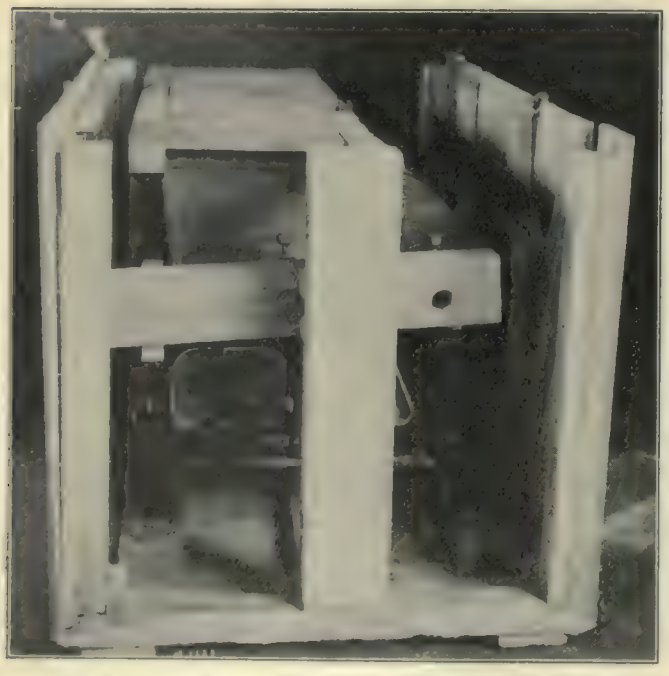

FIG. 3 COTTON GIN CRATE WITH END BLOCKS PLACED

Skewing can occur without introducing bending or torsional moments in cast iron ends.

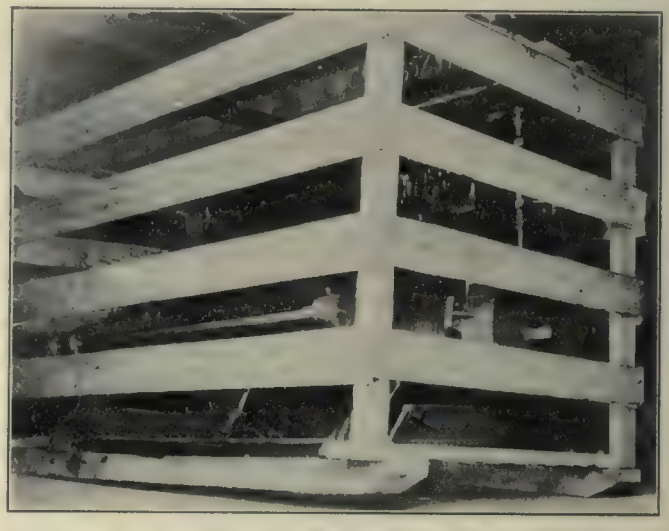

FIG. 4 MACHINE CRATED FOR DOMESTIC SHIPMENT

A concrete example may serve to illustrate this point. A manufacturer shipping enameled ovens for gas ranges was using the three-way corner crate braced diagonally on the ends and two sides. The top and bottom were not braced. The oven was fastened securely to the bottom of the crate and, while strong enough to brace it diagonally, was weak in resisting twisting. Consequently, when the crate was dropped on a corner the unbraced top tended to distort diagonally. The other faces of the crate were braced to resist diagonal distortion. The distortion in the top of the crate caused all the faces to warp out of a plane. The warping of the bottom of the crate twisted the oven and caused the thin sheet metal to buckle and chip the enamel. This damage occurred without the crate coming in contact with the stove or the crate showing any damage. The difficulty was readily overcome by bracing the top of the crate.

The crate illustrated in Figs. 2 and 3 is an exceptionally strong container for export shipment of machinery, yet, previous to adopting the methods shown, much damage occurred to the contents because of faulty internal packing. The crate was built with heavy frame members securely reinforced with 2 by 4-in. diagonal braces and cross ties and was sheathed with $\frac{7}{8}$-in. tongued and grooved lumber. All joints were securely nailed and the container well strapped.

The machine is a cotton gin. Its ends are cast iron and carry two large full length shafts with heavy, rigidly-attached parts. The other parts of the gin

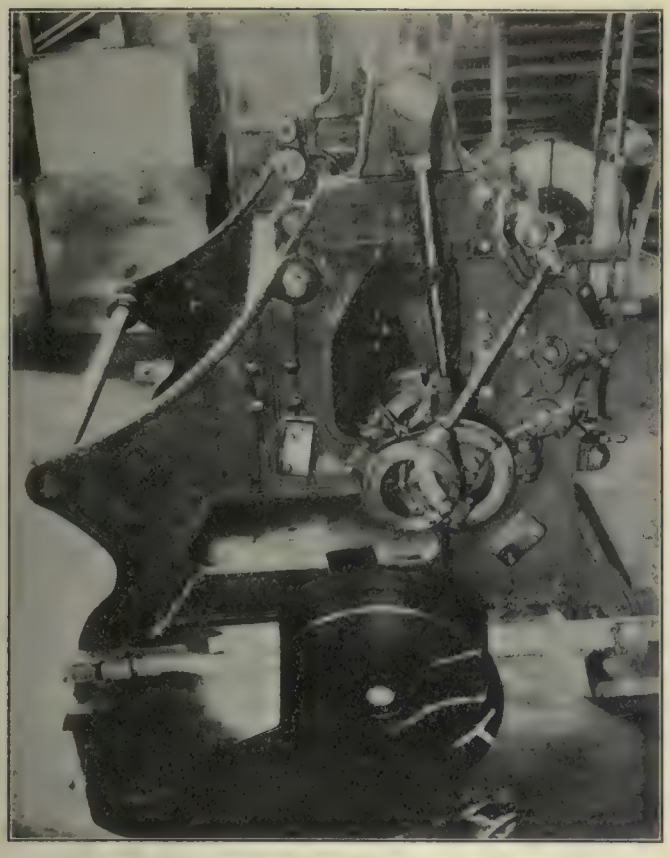

FIG. 5 MACHINE IN FIG. 4 DAMAGED IN SHIPMENT

are mostly wood. The original method of internal packing consisted in bolting the skids of the machine securely to the crate and blocking between the machine and the ends and sides of the crate. The top of the crate was tight against the machine. As can be readily seen, the original method required a crate which would withstand the hazards of transportation with practically no distortion, because any distortion would transmit the shocks of transportation directly to the machine or allow the crate to skew away from the ends of the heavy shafts and permit the entire end thrust of the shafts to come on the ends of the machine, giving rise to severe bending stresses in the cast iron.

It is impossible to build a crate which is as rigid as cast iron, because wood itself is somewhat yielding and there is always some looseness at nailed joints. Consequently, when the corner of this crate struck the pier, or any heavy rigid objects, the crate and the gin were both skewed diagonally—necessarily so because the two were bolted together and blocked securely. Such distortion was sufficient to twist the ends of the machine and break the cast-iron legs. Again, if the crate were dropped on the top or bottom edge of the end, the machine would be distorted lengthwise and failures were likely to occur in the end casting where the shafts were fastened; also the weight of the shafts would tend to spring the end of the crate and allow a large portion of the end thrust of the shafts to come on the castings. This end thrust was sufficient in itself to cause failures in the end castings without any twisting. The machine is amply strong to withstand drops flatwise on the sides, top, or bottom or on the edges of these faces.

To overcome the difficulty, obviously, was not a problem of building a more rigid crate but of blocking the machine so that the crate could distort slightly and absorb the shocks of transportation without transmitting them to the cast-iron ends in the form of severe bending or torsional moments.

In the improved method of packing which the Forest Products Laboratory was able to suggest, the bolts fastening the machine to the crate were taken out and each end of the machine was blocked with two 4 by 8-in. timbers placed at right angles. The horizontal timber was placed across the end of the machine about midway between top and bottom and was fitted against the machine at several points, including the shaft bearings, which thus became capable of preventing the shaft from moving endwise. This timber was not fastened to the crate in any way.

The vertical timber, which was also 4 by 8-in. in cross section, was placed about in line with the center of gravity of the machine in the other direction and was fastened securely to the top and bottom of the crate by sheet metal plates. This timber was to pre-

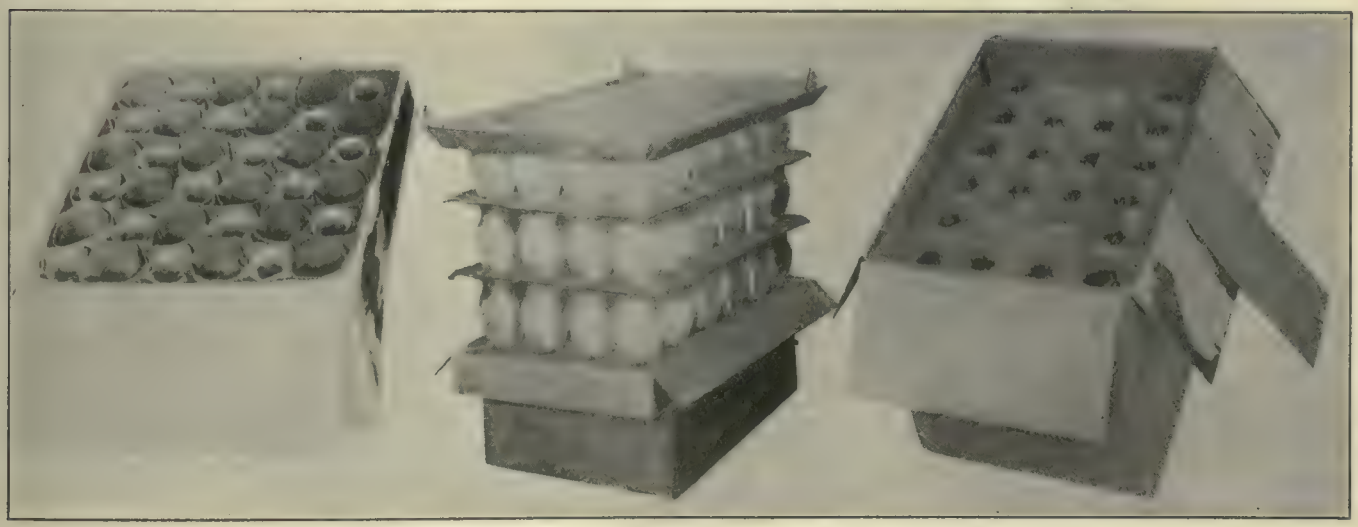

FIG. 6 OLD METHOD (LEFT) AND NEW METHOD (CENTER AND RIGHT) OF PACKING LAMP CHIMNEYS

vent the machine from moving endwise and to act as a pivoting block. The crate could then distort without skewing the machine. The original blocking was used on the sides and top. This arrangement of blocking permits the thrust on the end to be distributed to the parts of the machine best able to withstand it. The crate itself absorbs the diagonal stresses which formerly introduced skewing in the machine. The machine is thus required to withstand only direct load and end thrust, with little bending and torsion.

Fig. 4 illustrates a common method of crating machinery for domestic shipment. The machine was bolted to heavy skids and covered by light crating, which was intended primarily to protect the machine from other objects falling against it. It was loaded lengthwise of the car and the skids were blocked to the floor. Fig. 5 shows part of the damage which occurred during shipment. Similar damages occurred at the other end of the machine. The top of the machine was comparatively heavy, and the damage was apparently caused by a severe shock endwise when the car was being shifted. The crating and packing appeared to be amply strong for normal shipment. Damage from abnormal shocks such as occurred with this particular shipment could have been prevented by any of three methods, as follows: (a) By bracing diagonally from the car floor to the heavy parts near the top of the machine; (b) by bracing diagonally from the heavy parts of the top of the machine to the far end of skids; or (c) by loading the machine crosswise of the car. The machine in that position was amply strong to withstand the shocks. Even when loaded crosswise, however, it would probably be advisable to brace the top to the car floor so as to prevent tipping over with severe end shocks on the car. It would not have been practical to block the machine to the top of the crate and make the crate rigid enough to resist distortion.

Another illustration of the importance of internal packing is shown in Fig. 6. At the left is illustrated a method of packing lamp chimneys which resulted in considerable breakage. The chimneys were covered with individual corrugated strawboard wraps and were packed in a double-faced corrugated box. The resulting breakage was caused by the upper rows of chimneys crushing down upon the lower ones when the box was dropped flat on the end or side. Increasing the depth of the corrugations in the individual wraps and using boxes of double thickness and pads of various kinds reduced the breakage only slightly. Since the wraps offered very little resistance to collapse, such methods of packing did not materially reduce the amount of pressure exerted on the bottom layer of chimneys.

Suspending each individual chimney in die-cut pads made of double-faced corrugated fiber board, as shown at the center and right in Fig. 6, prevented practically all breakage. By this means each chimney is required to carry only its own weight and is so spaced that it does not come in contact with other chimneys or with the sides of the shipping container.

Uniform Invoice Is Widely Accepted

TO do away with duplication of work and to save time and avoid confusion in the billing and purchasing departments of the Ford Motor Company, F. H. Diehl, purchasing agent for the company, devised an invoice form of such evident superiority that it is now used or being adopted by upwards of 600 other American manufacturing firms. Its characteristics, as shown in Fig. 1, are: A definite place for the buyer's name and address, permitting the use of window envelopes; a space below this for shipping instructions and data; a space to the right of these two sections for use by the customer in checking and approving the bill for payment, to standardize such methods, and to eliminate the use of the miscellaneous rubber stamps usually employed, which obscure entries on the invoice; and ample room on the remainder of the sheet for the correct listing and billing of the various items purchased.

The present heterogeneous assortment of invoices coming into the offices of manufacturing plants—all sizes of paper, all kinds of arrangements, some with superfluous data, some with insufficient entries to identify the goods, and most of them with no space left in which to enter checking and approval for payment signatures—are bad enough as examples of poor management. Worst of all, they involve unnecessary expense at both ends. The new form prevents all this loss.

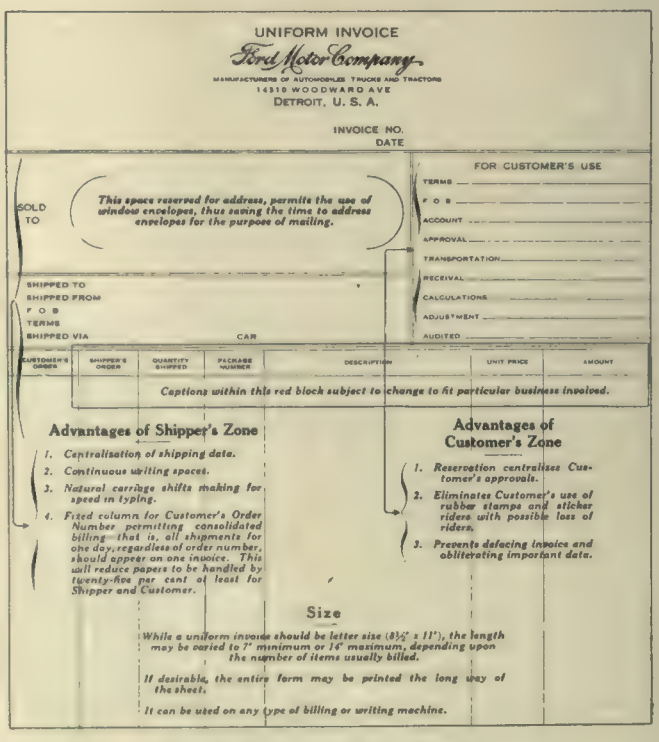
UNIFORM INVOICE
Ford Motor Company
MANUFACTURERS OF AUTOMOBILES TRUCKS AND TRACTORS
14310 WOODWARD AVE
DETROIT, U. S. A.
INVOICE NO.
DATE
FOR CUSTOMER'S USE
TERMS
F O B
ACCOUNT
APPROVAL
TRANSPORTATION
RECEIVAL
CALCULATIONS
ADJUSTMENT
AUDITED
SOLD TO
This space reserved for address, permits the use of window envelopes, thus saving the time to address envelopes for the purpose of mailing.
SHIPPED TO
SHIPPED FROM
F O B
TERMS
SHIPPED VIA
CAR
CUSTOMER'S ORDER
SHIPPER'S ORDER
QUANTITY SHIPPED
PACKAGE NUMBER
DESCRIPTION
UNIT PRICE
AMOUNT
Captions within this red block subject to change to fit particular business involved.
Advantages of Shipper's Zone
1. Centralization of shipping data.
2. Continuous writing spaces.
3. Natural carriage shifts making for speed in typing.
4. Fixed column for Customer's Order Number permitting consolidated billing—that is, all shipments for one day, regardless of order number, should appear on one invoice. This will reduce papers to be handled by twenty-five per cent or least for Shipper and Customer.
Advantages of Customer's Zone
1. Reservation centralizes Customer's approvals.
2. Eliminates Customer's use of rubber stamps and sticker riders with possible loss of riders.
3. Prevents defacing invoice and obliterating important data.
Size
While a uniform invoice should be letter size (8½" x 11"), the length may be varied to 7" minimum or 16" maximum, depending upon the number of items usually billed.
If desirable, the entire form may be printed the long way of the sheet.
It can be used on any type of billing or writing machine.

FIG. 1 UNIFORM INVOICE FORM
Developed to Standardize Billing Practice.

The Barth Standard Wage Scale

BY CARL G. BARTH

Consulting Engineer

THE belief is growing that the adoption of preferred numbers in American manufacturing and industry is quite as much a management as an engineering responsibility. The result of the use of these numbers in design, as is well known, is a series of sizes or proportions arranged in geometrical progression.

Carl G. Barth has long been an advocate and user of this principle of design, having embodied it for years in the arrangement of feeds and speed for machine tools. His work in this field is well known.

But not many are acquainted with his application of this same principle in arranging a series of wage rates. Thus this article, which describes wage scale, is of interest from several points of view.

Mr. Barth's method is worthy of study because of its psychological basis. It is an application of the fundamental of Weber's law of discrimination, which declares that for sensations or responses in arithmetical relationship the corresponding stimuli form a geometric series.—The Editors.]

It is now some 40 years since my employer at that time gave me a substantial increase in wages, incidentally remarking in the course of a little kindly chat on that occasion, that the greater a man's wages, the greater should also be any increase of the same, as from time to time his services grew more valuable. While not reflecting particularly on this remark at the time, it has always come back to me on every occasion on which I, in later life, experienced a change in my wages or salary, until I finally adopted it as a guiding principle when I eventually was placed in positions where it became my unpleasant duty to estimate other men's services and decide on the remuneration they deserved.

First Used for Machine Hour Rates

When in the year 1904 I, for the first time, was put to work by Mr. Taylor to calculate a series of machine hour rates, and these naturally came out in all sorts of odd figures, I at once proposed to the president of the company for whom the work was being done, to construct a standard scale or series of machine hour rates, and then select for each machine the nearest standard rate to its calculated rate. To this he immediately gave his consent, as he realized with me that the calculated machine rates had a basis in assumed facts not reliably ascertainable between rather large limits, and that considerable economy of clerical labor would result from a limited number of rates. After giving the matter some study and submitting a few propositions to the judgment of both the president and the manager of the company, and with the further suggestion that all rates should be in even cents and not be burdened by fractions, a series of rates varying as nearly as possible by 15 per cent was decided on.

Applied to Day Wage Earners

Later I also suggested that a similar series of rates be adopted for the day wage earners. To this the president at first raised a rather far-fetched objection, based on certain pet ideas he had cherished for years regarding men's relative wages. These he later withdrew at the persuasion of the manager, who as a real diplomat had more influence with him than I had, and who agreed with me that those ideas were bosh.

That is all there is to my standard wage scale, the construction of which is so simple that I have never kept a record of it, and hence I always had to reconstruct it for every concern I have cared to persuade to adopt it, probably only a half dozen all told. It is one of those things, the value of which is at once recognized by some individuals, but of which it is so fruitless to try to convince others that life is too short to waste in the attempt.

Construction of Scale Very Simple

Beginning at 10 cents and going to $3.00 per hour, the series is quickly read off on the slide rule, by setting the 1 mark on the slide opposite to 1.15 on the fixed scale, with the following results:

10, 12, 14, 16, 18, 21, 24, 28, 32, 37, 43, 49, 56, 64, 74, 85, 98, 1.13, 1.30, 1.50, 1.72, 1.98, 2.28, 2.62, 3.00

There are little initial difficulties connected with the establishment of a wage scale of this kind, even when the management gives it its full support, but the greatest difficulty I have met with is the objection raised by most managers to what they consider an unduly high raise from one rate to the next when a wage is already fairly high; and this because they are used to thinking in arithmetical progression only in such matters, and it is difficult in a limited time to convince them of the value and correctness of thinking in geometrical progressions, that is, in per cent increases. The kernel of the matter is really that nobody can determine the value of the services of another even as closely as 15 per cent. However, I have shown how the fundamental idea was not lacking in my own first employer of 40 years ago, even though he had no notion of a standard rate scale.

CURRENT INFORMATION INDEX
FOR THE MANAGEMENT

The material indexed in this department is selected by the editors of MANAGEMENT AND ADMINISTRATION from upwards of 100 magazines; it also includes the publications of some 50 book publishers and professional societies so far as these are of managerial interest to manufacturing executives. The number at the right of each item is the index symbol according to the Dewey Decimal Classification System. If articles are clipped and filed according to these numbers, like subjects will automatically fall together and related subjects will follow in logical sequence. The books and pamphlets indexed can be procured from the Management Publication Corporation or from their respective publishers. Photostat copies (white printing on black background) of any magazine article indexed can be obtained at a *price of 25 cents the page*, by addressing the Engineering Societies Library, 29 West 39th Street, New York City. Remittance must accompany the order. When ordering photostats please quote from the index: (1) Title of article; (2) Index number; (3) Name, date, and page numbers of periodical in which the item appears. The editors will be glad to furnish on request additional information in regard to the management of manufacturing industries, and on industrial buildings and equipment.

Industrial Buildings and Plant Maintenance

Buildings and Equipment

Factors of Industrial Housing. 658:692.5
Russell J. Waldo. MANAGEMENT IN MANUFACTURING, Nov. 1925, pp. 251-254. Illus. Based on a survey of 88 housing projects, and giving reasons for undertaking these projects, typical plans adopted and detailed cost data on layout and construction, well arranged for future reference.

Influence of Plant Design on Plant Efficiency. 658.2
Harold T. Moore. *Mechanical Engineering*, Mid-November 1925, pp. 1059-1060. Economical selection of site. Basic data on which to determine design. Limitations to plant layout. Design of the plant.

"Is My Lighting a Drag on Production? How Can I Tell?" 658.24
Ward Harrison and Roy A. Palmer. *Factory*, Nov. 1925, pp. 725-727, 762. Illus. Advantages and economies of modern factory illumination.

Light, Sight and Safety. 658.24
R. E. Simpson. *Factory*, Oct. 1925. pp. 541-543. Illus. Develops the point of view that the cost of adequate lighting in the factory is an insignificant item of overhead expense which will be returned many times over in production.

Principles of Ventilation in Hot Industries. 658.25
Keith J. Fanshier. *Gas Age-Record*, Nov. 7, 1925, pp. 671-672, 676.

The Modern Manufacturing Plant. E. R. Squibb and Sons Complete the First Unit of a Thoroughly Planned New Building Program at the Brooklyn Plant. 658.2
MANAGEMENT IN MANUFACTURING, Dec. 1925, pp. 339-342. Illus. Large 13 story reinforced concrete structure connects at 6 floors with older buildings and is result of a carefully studied manufacturing plan.

Southern Increases Its Car Repair Facilities. 658.2
A. B. Brown. *Railway Mechanical Engineer*, Nov. 1925, pp. 699-704. Illus. New shop at Hayne, S. C., has monthly output of about 80 passenger and 500 freight cars. Description of plant and equipment.

Ways of Obtaining the Best Lighting. 658.24
A. G. Anderson. MANAGEMENT IN MANUFACTURING, Dec. 1925, pp. 345-348. Illus. Maintenance of equipment very important. Cost of lighting, systems of illumination, and methods of calculating and laying out a factory lighting system.

Maintenance and Repair

Importance of Cleanliness. 658.239
K. D. Hamilton. *Factory*, Oct. 1925, pp. 557-561, 604, 608, 610, 612, 614, 616, 618. Illus. Methods of the George E. Keith Co. in obtaining cleanliness in its shoe plants.

Let's Face the Sanitation Question. 658.239
K. D. Hamilton. *Factory*, Nov. 1925, pp. 742-744, 768, 772, 774, 776, 778. Illus. Methods of checking waste and improving sanitation applied in the plant of the George E. Keith Co.

General Management and Policy

Administration and Policy

Policy and Policy-Making. 658
Oliver Sheldon. *Harvard Business Review*. Oct. 1925, pp. 1-6. Discussion of the elements or principles which enter into the determinative function of management or the fixing of policy.

Economics and General

American Booktrade Directory, 1925. 655.5
R. R. Bowker Co., New York. 255 pp. $7.50. A complete and up-to-date directory of publishers in the United States; booksellers in the United States; territories and possessions, North, Central and South America, Australia, New Zealand, China, Japan, India and Java; British publishers; American representatives of British publishers; Canadian publishers; auctioneers of literary property—United States; periodicals; book-trade organizations; publishing clubs; and reviewing mediums for book publishers.

Business Cycle and the Cotton Industry. 338.97:677
Louis Bader. *Textile World*, Oct. 31, 1925, pp. 31-33. Relationship between the growth of machinery in the cotton industry of the United States and the consumption of cotton. The installation of machinery has grown more rapidly.

Chemistry in Industry. 66
Edited by H. E. Howe. The Chemical Foundation, Inc., New York. 392 pp. $1. This second volume on chemistry in industry is a worthy successor of the first which had an unusually wide and satisfactory distribution. In a way it is an extension of its predecessor and it is intended to satisfy the demand of those who desire further information dealing with industries which could not be included in the first book. The products and processes covered are: Casein, candy, earthenware, electric batteries, explosives, glues, inks, lubricants, matches, paints, cement, rayon, soap, and some others.

Future of the Machine Tool Industry. 338.97:621.9
O. B. Iles. *Mechanical Engineering*, Nov. 1925, pp. 894-896. A forecast covering the next 15 or 20 years, dealing with design, construction, and business phases, and based on opinions held by leaders in the industry.

Special Libraries Directory—1925. 658.3853
Edited by Rebecca B. Rankin. Special Libraries Association, New York. 254 pp. $4. The special library is being developed with a true appreciation of its immense possibilities. This has been

brought about by an invasion of the library field by manufacturers, engineers, scientists and business and professional men. The man in active affairs has come to realize that experience crystallized in print is a working tool, and that, all other things being equal, success is on the side of the one who has the best organized information to bear upon current problems. This book gives a classified list of the special libraries in the United States.

Management

A Planning Department — for What? 658.51
W. L. Carver. *Automotive Industries,* Oct. 29, 1925, pp. 734-736. Emphasizes the need of understanding the functions of the planning department to cover not only production but also market conditions and sales possibilities.

Capitalizing the Advantages of the Small Factory. 658
Dale S. Cole. *Industrial Management,* Nov. 1925, pp. 265-269. Study of the question whether or not the small shop should go in for large orders which mean a price cut or other deviation from practice.

"Every Machine 95 Per Cent Busy Every Month." 658
Charles S. Pearce. *Factory,* Nov. 1925, pp. 716-719, 844. Methods used by the Palmolive Co. to co-ordinate sales and purchasing, and stabilize production on 1,000 items of output.

Factory Methods for the Small Manufacturing Plant. 658
J. E. Dykstra. *American Machinist,* Oct. 8, 1925, pp. 569-572. Illus. Methods used by the Champion Chemical Company to control stores and routing, determine the amount of premium allowance, record the sequence of operations, and secure information to act as a basis for costs.

Graphic Table Combining Logarithms and Anti-Logarithms. 510.8
Adrien Lacroix and Charles L. Ragot. Macmillan Co., New York, 57 pp. $1.40. A new and very convenient presentation of logs for ready reference, useful to all who deal with mathematics in design and statistical departments, etc., in manufacturing plants. The graphical combining of each number and its logarithm makes the tables "two-way" instead of "one-way," which is a characteristic of the old scheme. Moreover, interpolations are made by direct inspection. One section gives direct readings of 5 place numbers and 5 place logs, condensing this portion from the ordinary 380 pages down to 40 pages, with equal accuracy of results.

Graphical Methods of Calculation. 311
Herbert L. Seward. *Mechanical Engineering,* Mid-November 1925, pp. 1019-1033. Illus. Construction of cartesian diagrams and alignment charts.

Harvard Business Reports. Vol. I. 658
Compiled by the Graduate School of Business Administration, Harvard University. A. W. Shaw Company, Chicago. 561 pp. $7.50.

In this volume are brought together 149 cases selected from the files of the Harvard Graduate School of Business Administration. Each case has been included for significant reasons and as a guide to sound business management. The problems concerned are very wide in classification including those which originate in the shop, such as inspection, control of production and tools, production under wage rulings, production control, departmental arrangement to produce special parts, time study procedure, and the like. Others have to do with office functions, as the enforcement of contracts, cost accounting, salesmen's compensation, sales quotas, acceptance of special orders, budgetary control, etc.; others concern financial operation, such as capital investment, use of surplus funds, inventory liquidation, purchase of municipal bonds, and sale of bonds. The volume contains a wealth of valuable information bearing on the actual solution of manufacturing and business problems.

How the Automobile Industry Selects Equipment. 658.27
Machinery, Oct. 1925, pp. 87-92. Illus. Daily production studied; problem of breakdowns; special machines; selecting machines for low-cost, quality output; maintenance costs; ease of operation; mechanical features required; standardizing purchasing policy. II—Nov. 1925, pp. 184-189. Illus. Procedure in selecting equipment; functions of estimating department and chief tool designer in selection; turning machines; gear-cutters; drilling machines; grinders; lapping machines.

Manual of Office Practice. 651:69
Frederick J. Adams. Chas. Scribners Sons, New York. 96 pp. $1.25. This small book is a condensed tabulation of instructions covering the routine of an architectural office. It is intended to give information for the various grades of employees and others who have to do with the work of building construction.

Modern Business English. 651.7
A. Charles Babenroth. Prentice-Hall, New York. 466 pp. $4. Intended for young men and women in business or about to enter business. Presents the point of view of business English; essential qualities of writing, such as consideration, construction, compactness, correctness, character, concreteness and cheerfulness; dressing the letter; methods of writing the sales letter; appeals to special classes; follow up letters; inquiries, credits and collections; adjustments; applications and reports.

Story of Link-Belt. 658
Link Belt Company, Chicago. Booklet. 50 pp.
A most readable anniversary volume has been prepared by the Link-Belt Company commemorating its 50th anniversary. In it are sketched first the idea of a link-belt, the securing of the first patents, the development of the business therefrom, with ample picturing of the personalities which made it all possible, stressing the growth from incorporation down to the present time with a wide spread of product and the strong organization which is now responsible for the firm and carrying it forward. Among such volumes this is easily a leader and is well worthy of the few moments required to read through its interestingly written pages.

We Harnessed the Sports Instinct. 658.5671
H. M. Robins. *Factory,* Oct. 1925, pp. 544-546. Illus. Description of methods used by the Westinghouse Lamp Company to reduce shrinkage of material resulting from spoilage. The result of the contest was an average improvement of 30 per cent of material efficiency.

We Lower Our Scrap Loss by Advertising It. 658.5671
J. V. Carlson. *Factory,* Nov. 1925, pp. 745-746. Illus. Methods used in the Union Special Machine Co. to reduce spoilage and defective workmanship. The practical result is four-fifths reduction in the annual loss from spoiled materials.

What the Bureau of Standards Is Doing for American Industry. 658.516
George K. Burgess. *Industrial Management,* Nov. 1925, pp. 257-263. Illus. Function of the Bureau and a number of examples of its research that have saved vast sums of money.

Why Standardization? 658.516
C. E. Skinner. *Factory,* Nov. 1925, pp. 723-724, 748, 750, 752. A carefully written argument for manufacturing standardization prepared by the Chairman of the American Engineering Standards Committee.

Power Generation and Transmission

Fuel

Pulverized Coal in Modern Practice. 662.6
David Brownlie. *Black Diamond,* Oct. 17, 1925, pp. 436-437, 437-B. Illus. Recent developments in various countries point to enormous savings. General principles involved. Some specific installations. Oct. 24, 1925, pp. 460-461, 470. Illus. Operating results prove satisfactory. Fuels of widely differing grades and qualities equalized by processes. Oct. 31, 1925, pp. 484-485, 498. Illus. Study of latest developments. Various types of dryers. Excessive drying unnecessary. Combustion chamber construction.

Power Plant and Equipment

Automatic Voltage Regulators. 621.315
General Electric Co., Schenectady. Bulletin GEA-123, 60 pp. Description of regulators and their application for every voltage regulating requirement.

Gas Engines of the Maryland Plant of the Bethlehem Steel Company. 621.42
A. A. Raymond. *Mechanical Engineering,* Mid-November 1925, pp. 1007-1008. Illus. Details of installation of 18 large engines using blast-furnace gas. Data on tests and operating records.

Raw Water Distilling Plants for Producing Distilled Boiler Feed Make-Up Water. 621.1972
Joseph Price. Griscom-Russell Co., New York. Booklet, 39 pp. Free. Fifth addition, covering latest developments in central stations and industrial power plants. New diagrams show layouts and conditions under which evaporators can be advantageously used.

Power Plant Operation

Amazing Example of Fuel Waste. 658.261
Fred C. De Weese. *Power Plant Engineering*, Nov. 15, 1925, pp. 1152-1154. Article on the survey of an industrial power plant which revealed a fuel waste of $17,000 per year.

Comparative Merits of Central Station and Private Plant Service. 658.26
H. M. Toombs. *National Engineer*, Nov. 1925, pp. 509-511.

Power-Plant Operating Costs. 658.261
Egbert Douglas, Charles F. Bindrich, and Charles H. Bromley. *Power*, Oct. 27, 1925, pp. 639-641. A group of typical power plant operating costs from a variety of industries where steam was required for both heating and processing.

Results of an Engineering Study of Paper Coating Factory's Power Plant. 658.261
J. G. Berger. *Power*, Nov. 17, 1925, pp. 752-753. Illus. Report of the investigation and changes in a small industrial power plant. The change involved buying central station power beyond the limit of that developed by steam which could be used on exhaust furnished for processing. The annual saving amounted to more than $3700.

Supply of Industrial Power. 658.261
William Harrison Larkin, Jr. *Mechanical Engineering*, Mid-November 1925, pp. 993-1001. Illus. Discussion of the factors of performance of the engine and boiler rooms of industrial power plants. Its purpose is to assist factory managers to differentiate between good and poor power plant operation.

Unfailing Way to Reduce the Cost of Steam. 658.261
Hubert E. Collins. MANAGEMENT IN MANUFACTURING, Dec. 1925, pp. 333-337. Illus. The manager's responsibility extends to the correct determination of power plant costs. Instruments which are necessary to give records for such costs, and methods of using the records to reduce expenses.

Value of Higher Steam Pressures in the Industrial Plant. 658.261
William F. Ryan. American Society of Mechanical Engineers. Pamphlet. 19 pp. Discussion of the value of higher steam pressures in industrial power plants. The conclusion is reached that pressures of 1200 lb. per sq. in. may be used advantageously.

Power Transmission

Electrical Maintenance in Pulp and Paper Mills. 658.262
W. W. Cronkhite. *Paper Trade Journal*, Oct. 22, 1925, pp. 49-50.

Groundwork Necessary Before Erecting a Lineshaft. 621.82
George Trimm. *Industrial Engineer*, Nov. 1925, pp. 519-523, 554. Illus. Methods used to support and align shafting in various installations made in concrete, mill construction and other types of buildings.

Rewinding and Repairing Armatures and Motors. 658.262
Chester A. Williams, *Industrial Engineer*, Nov. 1925, pp. 525-528, 531. Illus. Methods and equipment used for 150 motors operating under severe service conditions, and shop tests and records that show the quality of the work, at the Providence Gas Co. plant.

Tension Ratio and Transmissive Power of Belts. 621.852
C. A. Norman. American Society of Mechanical Engineers. Pamphlet. 12 pp. Results of investigations into the increase of transmissive power of the slip conducted at Ohio State University. Rubber, leather, and fabric belts were used.

Visual Records System for Motor Failures. 658.262
Comer D. Hazen. *Industrial Engineer*, Nov. 1925, pp. 517-518, 554. Illus. Methods used at the Youngstown Sheet & Tube Co. to check performance and reduce production delays on over 3000 motors.

Marketing and Distribution

Purchasing and Selling

Co-operation Solves Problems of Distribution. 38(06)
Charles F. Abbott. *Iron Trade Review*, Oct. 1, 1925, pp. 821-823. Trade organizations offer opportunities for directing competition along proper channels. Relative importance of production, financing and selling analyzed.

Determining a Sales Quota Basis. 658.8
E. R. and P. W. Smith. *Harvard Business Review*, Oct. 1925, pp. 49-56. Discussion of the statistics and method used to fix the basis of buying habits relative to type of commodity for which the sales campaign is being organized.

Has the Limit of Safety Been Reached? 658.883
H. Parker Willis. *Automotive Industries*, Oct. 8, 1925, pp. 607-609. Nearly $2,000,000,000 of bank funds are now tied up in time payment credits on automobiles. Mr. Willis points out five ways in which he believes the situation might be improved.

Making "Better Competitors." 658.807
Iron Trade Review, Nov. 5, 1925, p. 1153. National Machine Tool Builders' committee outlines principles for training salesmen for benefit of themselves, employers and industry.

Price Stabilizing Suggested. 338.5
E. H. Gary. *Iron Trade Review*, Oct. 29, 1925, pp. 1085, 1121. Public and judicial opinion would support legitimate action by steel producers, with government sanction.

Principles of Personal Selling. 658.8
Harry R. Tosdal. A. W. Shaw Co., Chicago. 753 pp. Flexible binding. $6. Treats the subect from the standpoint that personal selling is an economic activity directed toward the satisfaction of economic wants. Nature and scope of selling; the salesman; psychological aspects of buying and selling; knowledge of the market; planning for personal selling; the interview; goodwill; selling to householders, retailers, wholesalers, manufacturers and export trade; the salesman's place in the organization; house policies; sales methods; relation of selling to advertising; selection, training, compensation and supervision of salesmen; credits and collections; stimulating salesmen; ethics of selling.

Selling Service With Machine Tools. 658.8
G. L. Erwin, Jr. *Iron Trade Review*, Nov. 12, 1925, pp. 1211-1212. Illus. Photographs, sample milling parts and a record test sheet are sent to customer while machine is in transit, to show him what to expect from the machine or fixture.

Packing and Shipping

Buick Saves $100 Per Car Exported. 658.7884
George F. Bauer. MANAGEMENT IN MANUFACTURING, Dec. 1925, pp. 329-332. Illus. A trial shipment of unboxed automobiles to Antwerp proves a complete success and paves the way for the complete elimination of the box in export automotive shipments.

Methods of Protecting Shipments. 658.7884
C. A. Plaskett. MANAGEMENT IN MANUFACTURING, Dec. 1925, pp. 353-356. Illus. Practical points on packing, such as bracing of crates, construction to eliminate weaving and twisting, and internal supports to avoid strains, bending moments, and consequent breakage.

Scientifically Developed Shipping Containers. 658.7884
C. M. Bonnell, Jr. *Mechanical Engineering*, Mid-November 1925, pp. 979-983. Illus. Classification of commodities and the yearly cost of their packing and shipping in American industry. Organized information on design, construction and tests of wooden boxes, crates, barrels and casks, methods of loading and bracing containers in cars.

Material Handling and Production Control

Material Control

Control of Material in Railroad Operation. 658.78
Arthur Lazarus. *Industrial Management*, Oct. 1925, pp. 198-204. Handling of stores department on Chicago, Great Western; Chicago, Rock Island and Pacific; Atchison, Topeka and Sante Fe; Great Northern; New York Central and Pennsylvania Railroads.

How We Avoid Excess Stocks While Eliminating the Production Peak. 658.78
Archbold H. Robinson. *Factory*, Nov. 1925, pp. 720-721, 818. Methods used by the Eastman Kodak Co. to control stock and provide finished product to meet both regular and irregular sales fluctuations without padding inventories.

Mechanical Handling

Electric Trucks in the Locomotive Repair Shop. 658.281
Harold J. Payne. *Railway Mechanical Engineer*, Nov. 1925, pp. 719-721. Illus. Applications to many kinds of work.

14 Gains in Our Shipping Room's War on Work. 658.2813
G. L. Gardiner. *Factory*, Oct. 1925, pp. 563-565. Illus. Description of a roller conveyor introduced to take the place of an older type of packing table used in preparing goods for shipment.

Handling Without Transferring. 658.2812
Matthew W. Potts. *Industrial Management*, Nov. 1925, pp. 296-300. Illus. Systems using monorail hoists and telphers simplify handling.

Material Handling Methods in the Edward G. Budd Plant. 658.281
W. A. Graf. MANAGEMENT IN MANUFACTURING, Dec. 1925, pp. 321-324. Illus. Handling sheet steel, dies, etc., in the largest all-steel auto body plant in the world, where many cranes, conveyor systems, and over 3500 industrial trucks of 17 varieties are in use. Auto fleet service.

Materials Handling. 658.281
Westinghouse Electric and Manufacturing Co., East Pittsburgh. Motor application circular No. 7378. 32 pp. Data on principal groups of materials handling machines, their uses, typical outputs, and suitable electric equipment. Cranes, hoists, winches, conveyors, coal loading machines, freight elevators, trucks, locomotives and dredges included.

Materials Handling Problems and Their Solution. 658.281
F. D. Campbell. *Mechanical Engineering*, Mid-November 1925, pp. 973-978. Illus. Distinguishes between material handling, which is a service function, and production. Discusses problems of movement of product in industrial plants in receipt, processing, assembly, packing, storing and shipping, and mechanical means best adapted to such movement.

What Cranes Are Doing to Reduce Handling's $3,000,000,000 Tax. 658.281
Factory, Nov. 1925, pp. 731-733, 806, 810, 814, 816, 818. Reports and costs of performance surveys in the application and use of cranes and similar equipment in manufacturing plants.

Production Methods and Control

An Effective Production Control System. 658.5
John J. Swan. MANAGEMENT IN MANUFACTURING, Dec. 1925, pp. 317-320. Illus. New and particularly efficient and direct method of controlling production and inventory, based on a recent thorough study and reorganization of methods in the Kelly Press plant of the American Type Founders Co.

Four Times the Production With No More Space. 658.5
Arthur Murray. *Factory*, Oct. 1925, pp. 533-535, 570, 572, 574, 576, 578. Illus. Methods used to increase the output of magnetos by the American Bosch Magneto Corp. from 20,000 to 40,000 per month.

Most Economical Number of Parts to Make at One Set-up. 658.5
John M. Christman. *Machinery*, Nov. 1925, pp. 182-183. Chart. Formula developed by use of following factors: cost of set-up, no. of parts used per day, no. that can be made per day, cost of labor, etc., per part, and storage cost factor.

Principles and Advantages of Optical Methods for Measuring Machine Parts. 658.562
Henry F. Kurtz. *Mechanical Engineering*, Mid-November 1925, pp. 987-992. Illus. Necessity of increasing the degree of accuracy in measurements is making many present methods inadequate or inconvenient. This paper describes four classes of optical instruments designed for machine measuring purposes.

Production Control in the Newsprint Industry. 658.5
George D. Bearce. American Society of Mechanical Engineers. Pamphlet. 16 pp. Illus. Outlines production methods used in the majority of North American mills making newsprint paper. Shows records and forms used. Mills exchange reports on mutual basis to gain benefit from new operating economies thus made possible.

Routing Work in a Machine Tool Plant. 658.512
Arthur L. Baker. *Machinery*, Nov. 1925, pp. 175-178. Illus. Production system adopted by Baker Bros., machine tool builders, after a study of a number of shops.

Some Aspects of Airplane Inspection. 658.562
J. J. Feeley. *Society of Automotive Engineers Journal*, Nov. 1925, pp. 441-447. Illus. Co-ordinating engineering and manufacturing activities. Inspection should be constructive and make sure that intentions of designers are being carried out. Sampling and testing materials. Inspection procedure for various processes.

Employment and Personnel Management

Employment and Training

Educating the Present Employee. 658.386
Bernard J. Mullaney. *Public Service Management*, Nov. 1925, pp. 136-137. A study by the Peoples Gas, Light and Coke Co., Chicago, proves conclusively that contracts with employees have twice as much influence on customers as quality of physical service itself, but employees must be properly trained actually to give good service to customers.

Foremanship. 658.386
Department of Manufacture, Chamber of Commerce of the U. S. Booklet. 47 pp. Free. The first of a series of volumes on industrial relationship planned by the U. S. Chamber of Commerce has just been issued under the title "Foremanship." This little book brings together the experience of more than 100 manufacturers who have conducted foremen training in their plants. Thus it deals with foreman training methods in practically every branch of industry and in manufacturing plants of widely varying sizes. It is intended to be a summary of helpful information and experience gathered from reliable sources.

Personnel

The Present State of Industrial Psychology. 658.3:15
Lillian M. Gilbreth. *Mechanical Engineering*, Mid-November 1925, pp. 1039-1042. Consideration of the facts surrounding handling of men and an evaluation of the methods already applied.

Structural Features of Shop Committee Plans. 658.31514
John W. Riegel. *Harvard Business Review*, Oct. 1925, pp. 17-31. Illus.

Workers' Participation in Job Study. 658.3:658.511
Geoffrey C. Brown. *American Federationist*, Nov. 1925, pp. 1029-1038. Benefits to be derived from giving employees a share in studying job analysis.

Health and Safety

Carbon Dioxide as an Index of Fatigue. 658.544
Walter N. Polakov. *Mechanical Engineering*, Mid-November 1925, pp. 1043-1046. Illus. (Also abstracted in MANAGEMENT IN MANUFACTURING, Dec. 1925, pp. 343-344). New method of indicating fatigue and relating it to physical exertion. The method is based on the second law of thermodynamics and consists in measuring the CO_2 content in exhaled breath.

Cement Plant Without an Accident for 365 Days. 658.3823
L. M. McDonald. *Cement, Mill and Quarry*, Oct. 20, 1925, pp. 23-24. Plant No. 8 of the Canada Cement Co. institutes safety plans and education which have eliminated all accidents since Sept. 25, 1924.

Experience of a Gypsum Plant in Accident Prevention. 658.3823
J. R. Davis. *Cement, Mill and Quarry*, Oct. 20, 1925, pp. 15-16. Methods at the United States Gypsum plant at Genoa, Ohio, whereby lost time due to accidents was reduced 89 per cent in two years, and 97 per cent in the quarry in one year.

Eye Sight Conservation. 613.49
Issued by the Eye Sight Conservation Council of America, New York. 218 pp. $1. This report shows the progress of eye sight conservation and gives an assembled mass of facts in regard to pertinent topics under this general heading. Because of the free use of references it becomes as well a resume of the most important literature and findings. The chapter headings are: Eye Hygiene; Eye Defects; Eye Diseases; Eye Sight and Education; Eye Sight and Occupation; Eye Protection; Illumination; Eye Sight of Noted Persons.

New Method of Taking Up Safety Work With Employees. 658.3823
Russell A. Sears. *Electric Railway Journal*, Oct. 10, 1925, pp. 650-652. A contest was arranged by the Boston Elevated Railway and the 10 men passing the examination best were sent to the National Safety Council congress.

Safety in Materials Handling. 614.8:621.86
David S. Beyer. American Society of Mechanical Engineers, pamphlet, 30 pp. Illus. Points out that a yearly loss of $250,000,000, and one-third of all industrial accidents, are due to accidents in handling materials. Classifies such accidents and points out means of prevention. Stresses importance of specifying preventive measures in construction drawings.

Organizing for Safety Work. 658.3823
George Hodge.. *Iron Trade Review*, Oct. 15, 1925, pp. 961-962. Committee co-ordinates employees and management. Department should function as service division to assist foremen. Based on International Harvester Co. practice.

Remuneration

Barth Standard Wage Scale. 658.32
Carl G. Barth. MANAGEMENT IN MANUFACTURING, Dec. 1925, p. 357. Based on a geometric progression of 1.15, with the idea that percentages of increase, and not arithmetical increases, are the greatest incentive to workmen.

Payment and Incentive in Industry. 658.32
C. Haslett. *Cassier's Industrial Management*, Oct. 1925, pp. 479-481. Description of several wage payment systems used in England and which are unknown in the United States.

Financial Control and Accounting

Financial Control

Financial (The) and Industrial Investigation. 658.1
Arthur Andersen. MANAGEMENT IN MANUFACTURING, Dec. 1925, pp. 325-328. Modern aids to management, definition of a financial and industrial investigation, sources of information, analysis, classifications of investigations, internal and external investigations and their future uses.

Use of Financial Ratios. 658.14
Harvard Business Review, Oct. 1925, pp. 79-93. Discussion and comparison of use of current ratios, net worth ratios and sales ratios in interpreting operating facts for the use of management. The general conclusion is that discriminating use of financial ratios will prove of considerable value in checking estimates of the company's condition secured from other sources.

Accounting and Cost Finding

Accounting for Values or Dollars. 657.4
Stephen McK. DuBrul. MANAGEMENT IN MANUFACTURING, Dec. 1925, p. 338. Points out the dangerous and deceptive nature of present methods of accounting which ignore the changing value of the dollar.

Budgetary Control in Cost Accounting. 657.452
Charles R. Stevenson. *Electric Railway Journal*, Oct. 17, 1925, pp. 701-702. Development of standard costs; determination of joint costs. How to evaluate by-products.

Known Costs Bring Greater Profit. 657.452
Charles F. Scribner. MANAGEMENT IN MANUFACTURING, Dec. 1925, pp. 349-352. Illus. Purpose of cost finding, standard costs for estimates, factory expense costs, administrative and selling expenses, and reports for managerial control, as applied in the management of southern furniture plants.

Production Budgeting. 658.14
J. L. Palmer. National Association of Cost Accountants Bulletin, Oct. 15, 1925, pp. 98-103. Presentation of the various steps in preparing a production budget, which involves: (1) An estimate of manufacturing volume; (2) an estimate of raw material required; (3) an estimate of labor requirements; (4) estimates of manufacturing expenses.

Taking the Guess Out of Costs. 657.452
Curtis F. Moss. *Candy Factory*, Nov. 1925, pp. 72, 81. Illus. Profitable pricing impossible without accurate knowledge of production costs. Simple system suggested, with master card and budget cards for labor, material and equipment.

New Industrial Equipment

Dolly Truck. 621.869
No. 3 model Marion dolly truck, with larger wheels for use on rough floors, inclines, etc. Wheels are fibre or steel, as desired. Compact, simple, durable, and turns in short space. Suitable for manufacturing plants, railroads, etc. Easily loaded and unloaded without damage to crates, rolls, barrels and boxes. Made by Marion Tool Works, Inc.

Electric Hoist. 621.862
For loads up to 5 tons. Any standard make of motor can be applied. Extremely high lift. Construction simple; parts accessible, gears are hammered steel and case hardened, enclosed and running in lubricant; drum is of large diameter and grooved. Trade name, "Standartized Hi-Lift." Made by Northern Engineering Works.

Fuel Waste Meter. 621.1977
A fuel waste meter records the temperature of the escaping boiler flue gases and their percentage of CO_2 using but one chart for both records. It is thus possible to determine the fuel which has been used, in either dollars and cents, or B. t. u., or in per cent of fuel burned during any time interval. The instrument is manufactured by the Uehling Instrument Co.

Medium Pressure Valves. 621.1854
Bronze globe and angle valves, screwed or flanged ends, ¼ to 3 in. size, for 225 lb. working steam pressure. Bonnet and union in one piece to screw on outside of body threads, bonnet hexagon being especially large. New design of ball joint between bonnet and body. Renewable Jenkins special No. 800 composition discs eliminate need for regrinding. Spindle made of manganese bronze, with large, powerful threads. Deep stuffing box, asbestos packing, and bronze follower. Ventilated, malleable iron hand wheel. Made by Jenkins Bros.

Oil-operated Jack. 621.869
The Pedersen "Oiljak" is now on the market in 10 ton sizes to which will be added 6, 3, and one ton sizes as soon as they enter production. The jack is operated by raising a handle for which only an inch by inch motion is necessary, thus permitting use of the jack in cramped quarters. The needle valve controls speed of lowering which may be as slow or rapid as desired. This tool is manufactured by the Oil Jack Company, Inc.

MANAGEMENT AND ADMINISTRATION

CUMULATIVE INDEX TO VOL. X

JULY-DECEMBER, 1925

A

Accidents, Elimination of (See Safety)
ACCOUNTING FOR VALUES OR DOLLARS. DuBrul. Dec., 338
Acetylene Generators
Portable Acetylene Generator. (Industrial Equipment). July, 48
Allen, Ralph H.
Practical Results of Budgeting. July, 11-14
ALUMINUM RULES
Industrial Equipment. Sept., 160
AMERICAN MANUFACTURING MANAGEMENT SURE OF ADOPTION IN EUROPE. July, 5-6
Andersen, Arthur
The Financial and Industrial Investigation. Dec., 325-8
Anderson, A. G.
Do Branch Plants Pay? Oct., 187-90
How Good Lighting Benefits the Shop. Nov., 277-80
Ways of Obtaining the Best Lighting. Dec., 345-8
AROUSED EXECUTIVE INTEREST AIDS EFFECTIVE PRODUCTION CONTROL. Scribner. Oct., 217-20
Automobiles
Buick Saves $100 Per Car Exported. Bauer. Dec., 329-32

B

Balance Sheet Analysis
Practical Balance Sheet Analysis. Pelton. July, 27-8
Bangs, John R.
Manufacturing Procedure Simplified. Sept., 149-52; Oct., 213-6
Barth, Carl G.
The Barth Standard Wage Scale. Dec., 357
BARTH STANDARD WAGE SCALE. Barth. Dec., 357
Bartlett, Guy
General Electric Transportation. Oct., 191-4
Battery Charging
Economical Truck Battery Charging. Dec., 352
Bauer, George F.
Buick Saves $100 Per Car Exported. Dec., 329-32
BELL TELEPHONE SYSTEM BUDGET PLANS. Heiss. Sept., 133-6
Belting
Performance Data on Belting. Nichols. Nov., 259-60
Bench Vise
Drop-Forged Bench Vise. (Industrial Equipment). Oct., 226
BETTER MANAGEMENT PAYS IN TEXTILES. Thompson and Freeland. Oct., 209-12
BETTER SHIPPING CONTAINERS. Smith. July, 23-6
Boilers
Single Pass Steam Boiler. (Industrial Equipment). Nov., 294
Branch Plants
Do Branch Plants Pay? Anderson. Oct., 187-90
Budgeting (See also Selling)
Bell Telephone System Budget Plans. Heiss. Sept., 133-6
Practical Results of Budgeting. Allen. July, 11-14
BUICK SAVES $100 PER CAR EXPORTED. Bauer. Dec., 329-32
Buildings and Equipment (See also Concrete Housing; Lighting; Replacement Cost)
American Type Founders Company Builds Largest Automatic Printing Press Factory in the World. Fallon. Sept., 119-24
Concrete in Industrial Buildings. Hart. July, 29-32
E. R. Squibb and Sons Complete the First Unit of a Thoroughly Planned New Building Program at the Brooklyn Plant. Dec., 339-42
High (A) Substation. Nov., 284
Modern Equipment Brings Low Cost. Sept., 117-8
New Plant of the Hall Planetary Company Represents Marked Advance in Lighting, Heating and Power Transmission. Thomas. Nov., 261-4
New Westinghouse Transformer Factories at Sharon Represent the Latest in Building Practice. Champlain. Oct., 181-6
Procter and Gamble Plant Adds to Storehouse. Sept., 136

C

Carpenter, C. U.
Making a Success of the Small Manufacturing Business. Sept., 125-8; Oct., 195-8; Nov., 287-9
Champlain, C. H.
Testing Westinghouse Transformers. Nov., 265-6
The Modern Manufacturing Plant. New Westinghouse Transformer Factories at Sharon Represent the Latest in Building Practice. Oct., 181-6
Christensen, Anker L.
Worthington Methods of Tool Control III-VI. July 15-18; Aug., 95-7; Sept., 141-4; Oct., 201-4
Churchill, W. L.
Dangerous Selling Prices, Aug., 79-82
Collins, Hubert E.
An Unfailing Way to Reduce the Costs of Steam. Dec., 333-7
CONCRETE IN INDUSTRIAL BUILDINGS. Hart. July, 29-32
Cost Accounting (See also Power Plant Operation)
Distributing Steam Costs Correctly. Ramsey. Sept., 155
Known Costs Bring Greater Profit. (Management in Southern Furniture Plants). Scribner. Dec., 345-8
Methods of 42 Manufacturers in Distributing Expenses to Product. Reitell. Aug., 87-92
System for Budgeting Co-ordinated Sales and Production. Tingley. Aug., 67-70
$20,000 a Year Lost Through Wrong Power Figures. Sheehan. July, 39-40
Crane Boom
Telescoping Crane Boom. (Industrial Equipment). July, 48
Current Information Index
July, 44-48; Aug., 98-102; Sept., 156-60; Oct., 221-6; Nov., 290-4; Dec., 358-62

D

DANGEROUS SELLING PRICES. Churchill. Aug., 79-82
Depreciation Reserves
Accounting for Values or Dollars. DuBrul. Dec., 388
De Young, Dirk P.
Making Exports Balance Production. July, 19-22
DISTRIBUTING STEAM COSTS CORRECTLY. Ramsey. Sept., 155
DO BRANCH PLANTS PAY? Anderson. Oct., 187-90
Drills
Pneumatic Drill. (Industrial Equipment). Aug., 102
DROP-FORGED BENCH VISE
Industrial Equipment. Oct., 226
Du Brul, Stephen McKenzie
Accounting for Values or Dollars. Dec., 338

E

ECONOMICAL TRUCK BATTERY CHARGING. Dec., 352
EFFECTIVE (An) PRODUCTION CONTROL SYSTEM. Swan. Dec., 317-20
ELECTRIC CURVE DRAWING INSTRUMENTS. Ammeters, Voltmeters, Wattmeters. (Industrial Equipment). Nov., 294
ELECTRIC HOIST
Industrial Equipment. Dec., 362
ELECTRIC LIFT TRUCTORS
Industrial Equipment. July, 48
Electric Power (See Power Plant Operation)
Electric Power Apparatus
Standard Electrical Markings (for Electric Power Apparatus). Oct., 216
ELECTRIC RIVET HEATER
Industrial Equipment. Nov., 294
ELECTRIC TRUCKS AND STACKERS
Industrial Equipment. Oct., 226
Electrical Equipment (See device in question)
ELECTRICAL POWER COSTS. Ross-Ross. Nov., 285-6
Elevators (See also Stackers, Trucks)
Portable Elevator. (Industrial Equipment). Oct., 226
ELEVATOR TRUCTORS FOR OVEN CHARGING
Industrial Equipment. Oct., 226

Employee Training
Quality and Quantity of Output Depend upon Trained Employees. Scribner. Nov., 267-70
Employees (See Employee Training; Fatigue; Housing; Wage Payment)
ENGINE DRIVEN WELDER
Industrial Equipment. July, 48
EXECUTIVE CONTROL OF POWER ECONOMY. Polakov. Sept., 129-32
Export Trade (See Trade, Foreign)
Express System, Shop
Westinghouse Shop Express System. Lowry. July, 7-10; Aug., 75-8

F

FACTORS OF INDUSTRIAL HOUSING. Waldo. Nov., 251-4
Fair Trade Practice
Simplification and Fair Trade Practice, July, 14
Fallon, John F.
The Modern Manufacturing Plant. American Type Founders Company Builds Largest Automatic Printing Press Factory in the World. Sept. 119-24
Fatigue
New Method of Indicating Fatigue. Polakov. Dec., 343-4
$15,000,000 SALVAGED BY FORD PLANTS. Hagemann. July 33-6
Filing Equipment
Steel Filing Equipment. (Industrial Equipment). Oct, 226
FINANCIAL (The) AND INDUSTRIAL INVESTIGATION. Andersen. Dec., 325-8
Fish, E. H.
Getting Rid of Idle Machine Hours. Dec., 332
FORD PLANT ENLARGES POWER CAPACITY. Hagemann. Oct., 205-8; Nov., 273-6
Fordsons
Hoist Attachment for Fordsons. (Industrial Equipment). July, 48
Foremen's Association
National Association of Foremen. Oct. 220
Forsythe, H. J.
Hyatt Methods of Material Handling. Sept., 137-40
Freeland, Willard E. and Thompson, Sanford E.
Better Management Pays in Textiles. Oct., 209-12
FUEL WASTE METER
Industrial Equipment. Dec., 362
Furnaces
Portable Furnaces. (Industrial Equipment). July, 48
Furniture Plants
Management in Southern Furniture Plants. II-VI. Scribner. Aug., 83-6; Sept., 145-8; Oct., 217-20; Nov., 267-70; Dec., 349-52

G

GENERAL ELECTRIC HOME OWNING PLAN. Sept., 144
GENERAL ELECTRIC TRANSPORTATION. Bartlett. Oct., 191-4
GENERATOR SPEED INDICATING RELAY
Industrial Equipment. Nov., 294
GETTING RID OF IDLE MACHINE HOURS. Fish. Dec., 332
Graf, W. A.
Material Handling Methods in the Edward G. Budd Plant Dec., 321-4
Graham, Willard J.
Liquid Carbonic Sales Organization. Nov., 255-8
Grinder
Twist Drill Grinder. (Industrial Equipment), July, 48
GROUP PREMIUM FOR AN AUTOMATIC SCREW MACHINE DEPARTMENT. Houlihan. Nov., 281-4

H

Hagemann, George E.
$15,000,000 Salvaged by Ford Plants. July, 33-6
Ford Plant Enlarges Power Capacity. Oct., 205-8; Nov., 273-6
Hart, W. E.
Concrete in Industrial Buildings. July, 29-32
Heiss, C. A.
Bell Telephone System Budget Plans. Sept., 133-6
HIGH (A) SUBSTATION. Nov., 284
HOIST ATTACHMENT FOR FORDSONS
Industrial Equipment. July, 48
Home-Owning Plan
General Electric Home Owning Plan. Sept., 144
Houlihan, L. J.
Group Premium for an Automatic Screw Machine Department. Nov., 281-4
Housing, Industrial
Factors of Industrial Housing. Waldo. Nov, 251-4
HOW GOOD LIGHTING BENEFITS THE SHOP. Anderson. Nov., 277-80
Hudson, Ray M.
Six ways to Eliminate Waste. Aug., 71-4
HYATT METHODS OF MATERIAL HANDLING. Forsythe. Sept., 137-40

I

IMPROVED TYPE MOTOR STARTER
Industrial Equipment. Oct., 226
INCREASING POWER TO MEET DEMANDS. Moyer. July, 41-3
Index to Current Management Literature (See Current Information Index)
Indicating and Recording Instruments
An Unfailing Way to Reduce the Costs of Steam. Collins. Dec. 333-7
Electric Curve Drawing Instruments. Ammeters, Voltmeters, Wattmeters. (Industrial Equipment). Nov., 294
Level and Pressure Indicator and Recorder. (Industrial Equipment). Oct., 226
Portable A. C. or D. C. Instruments. (Industrial Equipment). July, 48
Recording Pyrometer. (Industrial Equipment). Sept, 160
60 In. Dial Power Meter. (Industrial Equipment). Aug., 102
Industrial Equipment (See also device in question). July, 48; Aug., 102; Sept., 160; Oct., 226; Nov., 294; Dec., 362
INDUSTRY MOVES TOWARD SIMPLIFICATION. Aug., 86
Instruments (See device in question)
Invoice
Uniform Invoice Is Widely Accepted. Dec., 356

J

Jack
Oil-operated Jack. (Industrial Equipment). Dec., 362

K

KNOWN COSTS BRING GREATER PROFITS. Scribner. Dec., 349-52

L

Labor Relations (See Employee Training; Fatigue; Housing; Wage Payment)
LEGAL PITFALLS IN MARKETING PRODUCTS. Montague. Sept., 153-4
LEVEL AND PRESSURE INDICATOR AND RECORDER
Industrial Equipment. Oct., 226
LIFT TRUCK PLATFORM
Industrial Equipment. Sept., 160
Lighting
How Good Lighting Benefits the Shop. Anderson. Nov., 277-80
28 Cases Where Good Lighting Paid. Waldo. Aug., 63-6
Ways of Obtaining the Best Lighting. Anderson. Dec., 345-8
Lincoln, J. F.
Welding Applied to Motor Production. July, 37-9
LOADING HOPPER INCREASES TRUCK EFFICIENCY. Aug., 92
Lowry, Stewart M.
Westinghouse Shop Express System. July, 7-10; Aug., 75-8

M

MAKING A SUCCESS OF THE SMALL MANUFACTURING BUSINESS. Carpenter. Sept., 125-8; Oct., 195-8; Nov., 287-9
MAKING EXPORTS BALANCE PRODUCTION. De Young. July, 19-22
Management (See also Accounting; Cost Accounting; Lighting; Production Control; Tool Control; Wage Payment; Waste Elimination; also items in question)
American Manufacturing Management Sure of Adoption in Europe. July, 5-6
Better Management Pays in Textiles. Thompson and Freeland. Oct., 209-12
Do Branch Plants Pay? Anderson. Oct., 187-90
Getting Rid of Idle Machine Hours. Fish. Dec., 332
Making a Success of the Small Manufacturing Business. Carpenter. Sept., 125-8; Oct., 195-8; Nov., 287-9
Management in Southern Furniture Plants II-VI. Scribner. Aug., 83-6; Sept., 145-8; Oct., 217-20; Nov., 267-70; Dec., 349-52
Manufacturing Procedure Simplified. Bangs. Sept., 149-52; Oct., 213-6
Skillful Use of Management Tools. Nov., 249-50
The Financial and Industrial Investigation. Andersen. Dec., 325-8
MANUFACTURING PROCEDURE SIMPLIFIED. Bangs. Sept., 149-52; Oct., 213-6

Material Handling (See also Containers; also equipment in question)
General Electric Transportation. Bartlett. Oct., 191-4
Hyatt Methods of Material Handling. Forsythe. Sept., 137-40
Loading Hopper Increases Truck Efficiency. Aug., 92
Material Handling Methods in the Edward G. Budd Plant. Graf. Dec., 321-4
Westinghouse Shop Express System. Lowry. July, 7-10; Aug., 75-8
MEDIUM PRESSURE VALVES
Industrial Equipment. Dec., 362
Mellen, George F.
Practical Lot Quantity Formulas. Sept., 155
Meters
Fuel Waste Meter. Records Flue Gas Temperature and Percentage of CO_2. (Industrial Equipment). Dec., 362
Recording Pyrometer. (Industrial Equipment). Sept., 160
60 In. Dial Power Meter. (Industrial Equipment). Aug., 102
METHODS OF 42 MANUFACTURERS IN DISTRIBUTING EXPENSES TO PRODUCT. Reitell. Aug., 87-92
METHODS OF PROTECTING SHIPMENTS. Plaskett. Dec., 353-6
MODERN EQUIPMENT BRINGS LOW COST. Sept., 117-8
MODERN (THE) MANUFACTURING PLANT
Kelly Press. Sept., 119-24
Westinghouse Electric and Manufacturing Co. (Sharon, Pa.). Oct., 181-6
Hall Planetary Co. Nov., 261-4
E. R. Squibb and Sons. Dec., 339-42
Montague, Gilbert H.
Legal Pitfalls in Marketing Products. Sept., 153-4
What Sales Executives Should Know About Dangers of Misinterpreting Trade Association Statistics. Aug., 93-4
Motor Starter
Improved Type Motor Starter. (Industrial Equipment). Oct., 226
Motors
Welding Applied to Motor Production. Lincoln. July, 37-9
Moyer, F. H.
Increasing Power to Meet Demands. July, 41-3

N

NATIONAL ASSOCIATION OF FOREMEN. Oct., 220
NEW DEVELOPMENTS IN SIMPLIFIED PRACTICE. Oct., 194
NEW METHOD OF INDICATING FATIGUE. Polakov. Dec., 343-4
NEW MODEL DOLLY TRUCK
Industrial Equipment. Sept., 160
NEW WORTHINGTON TOOL-CRIB SERVICE OPERATES WITH SATISFACTION. Christensen. July, 15-18
Nichols, W. W.
Performance Data on Belting. Nov., 259-60

O

OIL-OPERATED JACK
Industrial Equipment. Dec., 362
ORGANIZING THE TOOL CRIB PERSONNEL. Christensen. Sept., 141-4
Oven Charger
Elevator Tructor for Oven Charging. (Industrial Equipment). Oct., 226

P

Packing (See Shipping Containers)
PASSENGER TRAILER CAR. Nov., 270
Pelton, G. M.
Practical Balance Sheet Analysis. July, 27-8
PERFORMANCE DATA ON BELTING. Nichols. Nov., 259-60
Plaskett, C. A.
Methods of Protecting Shipments. Dec., 353-6
PNEUMATIC DRILL
Industrial Equipment. Aug., 102
Polakov, Walter N.
Executive Control of Power Economy. Sept., 129-32
New Method of Indicating Fatigue. Dec., 343-4
PORTABLE A. C. OR D. C. INSTRUMENTS
Industrial Equipment. July, 48
PORTABLE ACETYLENE GENERATOR
Industrial Equipment. July, 48
PORTABLE ELECTRIC STACKERS
Industrial Equipment. Nov., 294
PORTABLE ELEVATORS
Industrial Equipment. Oct., 226
PORTABLE FURNACE
Industrial Equipment. July, 48
Power Consumption of Machines
Performance Data on Belting. Nichols. Nov., 259-60
Power Equipment (See device in question)
Power Plant Operation
An Unfailing Way to Reduce the Costs of Steam. Collins. Dec., 333-7
Distributing Steam Costs Correctly. Ramsey. Sept., 155
Electrical Power Costs. Ross-Ross. Nov., 285-6
Executive Control of Power Economy. Polakov. Sept., 129-32
Ford Plant Enlarges Power Capacity. Hagemann. Oct., 205-8; Nov., 273-6
Increasing Power to Meet Demands. Moyer. July, 41-3
$20,000 a Year Lost Through Wrong Power Figures. Sheehan. July, 39-40
PRACTICAL BALANCE SHEET ANALYSIS. Pelton. July, 27-8
PRACTICAL LOT QUANTITY FORMULAS. Mellen. Sept., 155
PRACTICAL RESULTS OF BUDGETING. Allen. July, 11-14
Premiums (See Group Premiums)
Premiums for Salesmen
Legal Pitfalls in Marketing Products. Montague. Sept., 153-4
Pressure Indicator
Level and Pressure Indicator and Recorder. (Industrial Equipment). Oct., 226
Price Control
Legal Pitfalls in Marketing Products; Illustrations of "Hairline" Decisions. Montague. Sept., 153-4
Pricing (See also Cost Accounting; Price Control)
Dangerous Selling Prices. Churchill. Aug., 79-82
Printing Press Manufacturing
An Effective Production Control System. Swan. Dec., 317-20
PROCTER AND GAMBLE PLANT ADDS TO STOREHOUSE. Sept., 136
Production Control
An Effective Production Control System. Swan. Dec., 317-20
Aroused Executive Interest Aids Effective Production Control. (Management in Southern Furniture Plants). Scribner. Oct., 217-20
Practical Lot Quantity Formulas. Mellen. Sept., 155
Successful Methods for Increasing Sales and Balancing Production. (Management in Southern Furniture Plants). Scribner. Sept., 145-8
System for Budgeting Co-ordinated Sales and Production. Tingley. Aug., 67-70
Pyrometer
Recording Pyrometer. (Industrial Equipment). Sept., 160

Q

QUALITY AND QUANTITY OF OUTPUT DEPEND UPON TRAINED EMPLOYEES. (Management in Southern Furniture Plants). Scribner. Nov., 267-70

R

Ramsey, Harold E.
Distributing Steam Costs Correctly. Sept., 155
REAL SAFETY MOVEMENT TO COME. Aug., 61-2
Recording Instruments (See Indicating and Recording Instruments)
RECORDING PYROMETER
Industrial Equipment. Sept., 160
Reitell, Charles
Methods of 42 Manufacturers in Distributing Expenses to Product. Aug., 87-92
Rivet Heater
Electric Rivet Heater. (Industrial Equipment). Nov., 294
RIVET SET
Industrial Equipment. July, 48
Ross-Ross, Donald
Electrical Power Costs. Nov., 285-6
Rules
Aluminum Rules. (Industrial Equipment). Sept., 160

S

Safety
Real Safety Movement to Come. Aug., 61-2
SAFETY SWITCH
Industrial Equipment. July, 48
Scribner, Charles F.
Management in Southern Furniture Plants II-VI. Aug., 83-6; Sept., 145-8; Oct., 217-20; Nov., 267-70; Dec., 349-52
SELECTING THE PROPER CONTAINER. Oct., 199-200; Nov., 271-2
Selling (See also Invoice; Premiums for Salesmen; Price Control; Pricing; Trade, Foreign)

Bell Telephone System Budget Plans. Heiss. Sept., 133-6
Legal Pitfalls in Marketing Products. Montague. Sept., 153-4
Liquid Carbonic Sales Organization. Graham. Nov., 255-8
Making a Success of the Small Manufacturing Business (Part 3). How to Sell the Product. Nov., 287-9
Successful Methods for Increasing Sales and Balancing Production. (Management in Southern Furniture Plants). Scribner. Sept., 145-8
System for Budgeting Co-ordinated Sales and Production. Tingley. Aug., 67-70
What Sales Executives Should Know About Dangers of Misinterpreting Trade Association Statistics. Montague. Aug., 93-4

Sheehan, A. F.
$20,000 a Year Lost Through Wrong Power Figures. July, 39-40

Shipping Containers
Better Shipping Containers. Smith. July, 23-6
Buick Saves $100 Per Car Exported (Elimination of Boxing). Bauer. Dec., 329-32
Methods of Protecting Shipments. Plaskett. Dec., 353-6
Selecting the Proper Container. Oct., 199-200; Nov. 271-2

Simplification
Industry Moves Toward Simplification. Aug., 86
New Developments in Simplified Practice. Oct., 194

SIMPLIFICATION AND FAIR TRADE PRACTICE. July, 14

SINGLE PASS STEAM BOILER
Industrial Equipment. Nov., 294

SIX WAYS TO ELIMINATE WASTE. Hudson. Aug., 71-4

60 IN. DIAL POWER METER
Industrial Equipment. Aug., 102

SKILLFUL USE OF MANAGEMENT TOOLS. Nov., 249-50

Smith, Floyd T.
Better Shipping Containers. July, 23-6

SOUTHERN FURNITURE PLANTS APPLY MODERN MANAGEMENT WITH SUCCESS. (Management in Southern Furniture Plants). Scribner. Aug., 83-6

Speed Indicating Relay
Generator Speed Indicating Relay. Nov., 294

Stackers
Electric Truck and Stacker. (Industrial Equipment). Oct., 226
Portable Electric Stacker. (Industrial Equipment). Nov., 294

STANDARD ELECTRICAL MARKINGS (for electric power apparatus). Oct., 216

Standardization
Simplification and Fair Trade Practice. July, 14

STARTING SWITCH
Industrial Equipment. July, 48

Steam Cost (See Power Plant Operation)

STEAM SEPARATOR
Industrial Equipment. Aug., 102

STEAM TRAP
Industrial Equipment. Nov. 294

STEEL FILING EQUIPMENT
Industrial Equipment. Oct., 226

STEEL SWITCHBOARD
Industrial Equipment. Aug., 102

SUCCESSFUL METHODS FOR INCREASING SALES AND BALANCING PRODUCTION. (Management in Southern Furniture Plants). Scribner. Sept., 145-8

Swan, John J.
An Effective Production Control System. Dec., 317-20

Switches
Safety Switch. (Industrial Equipment). July, 48
Starting Switch. (Industrial Equipment). July, 48

Switchboards
Steel Switchboard. (Industrial Equipment). Aug., 102

SYSTEM FOR BUDGETING CO-ORDINATED SALES AND PRODUCTION. Tingley. Aug., 67-70

T

TELESCOPING CRANE BOOM
Industrial Equipment. July, 48

TESTING WESTINGHOUSE TRANSFORMERS. Champlain. Nov., 265-6

Textile Industry
Better Management Pays in Textiles. Thompson and Freeland. Oct., 209-12

Thomas, J. R.
The Modern Manufacturing Plant. New Plant of The Hall Planetary Company Represents Marked Advance in Lighting, Heating and Power Transmission. Nov., 261-4

Thompson, Sanford E., and Freeland, Willard E.
Better Management Pays in Textiles. Oct., 209-12

TIER LIFT TRUCKS
Industrial Equipment. Aug., 102

Tingley, Edward H.
System for Budgeting Co-ordinated Sales and Production. Aug., 67-70

Tool Control
Worthington Methods of Tool Control. III-VI. Christensen. July, 15-18; Aug., 95-7; Sept., 141-4; Oct., 201-4

Trade Associations Statistics
What Sales Executives Should Know About Dangers of Misinterpreting Trade Association Statistics. Montague. Aug., 93-4

Trade, Foreign
Buick Saves $100 Per Car Exported. Bauer. Dec., 329-32
Making Exports Balance Production. July, 19-22

Trailer Car
Passenger Trailer Car. Nov., 270

Transformers
Testing Westinghouse Transformers. Champlain. Nov., 265-6

Transportation
General Electric Transportation. Bartlett. Oct., 191-4

Trucks (See also Elevators; Stackers; Tructors).
Dolly Truck. (Industrial Equipment). Dec., 362
Electric Truck and Stacker. (Industrial Equipment). Oct., 226
Lift Truck Platform. (Industrial Equipment). Sept., 160
Loading Hopper Increases Truck Efficiency. Aug., 92
New Model Dolly Truck. (Industrial Equipment). Sept., 160
Tier Lift Truck. (Industrial Equipment). Aug., 102

Tructors (See also Elevators; Stackers; Trucks).
Electric Lift Tructor. (Industrial Equipment). July, 48
Elevator Tructor for Oven Charging. (Industrial Equipment). Oct., 226

28 CASES WHERE GOOD LIGHTING PAID. Waldo. Aug., 63-6

$20,000 A YEAR LOST THROUGH WRONG POWER FIGURES. Sheehan. July, 39-40

TWIST DRILL GRINDER
Industrial Equipment. July, 48

U

UNDERVOLTAGE DEVICE
Industrial Equipment. Aug., 102

UNFAILING (AN) WAY TO REDUCE THE COSTS OF STEAM. Collins. Dec., 333-7

UNIFORM INVOICE IS WIDELY ACCEPTED. Dec., 356

V

Valves
Medium Pressure Valves. (Industrial Equipment). Dec., 362

Vise
Drop-Forged Bench Vise. (Industrial Equipment). Oct. 226

Voltage Regulator
Undervoltage Device. (Industrial Equipment). Aug., 102

W

Wage Payment
Group Premium for an Automatic Screw Machine Department. Houlihan. Nov., 281-4
The Barth Standard Wage Scale. Barth. Dec., 353

Waldo, Russell J.
Factors of Industrial Housing. Nov., 251-4
28 Cases Where Good Lighting Paid. Aug., 63-6

Waste Elimination (See also Power Plant Operation).
Getting Rid of Idle Machine Hours. Fish. Dec., 332
Simplification and Fair Trade Practice. July, 14
Six ways to Eliminate Waste. Hudson. Aug., 71-4

Waste Reclamation
$15,000,000 Salvaged by Ford Plants. Hagemann. July, 33-6

WAYS OF OBTAINING THE BEST LIGHTING. Anderson. Dec., 345-8

Welder
Engine Driven Welder. (Industrial Equipment). July, 48

WELDING APPLIED TO MOTOR PRODUCTION. Lincoln. July, 37-9

WESTINGHOUSE SHOP EXPRESS SYSTEM. Lowry. July, 7-10; Aug., 75-8

WHAT SALES EXECUTIVES SHOULD KNOW. Montague. Aug., 93-4

WORTHINGTON METHODS CUT TOOL COSTS. Christensen. Oct., 201-4

WORTHINGTON TOOL CONTROL METHODS. Christensen. Aug., 95-7

WORTHINGTON TOOL-CRIB SERVICE OPERATES WITH SATISFACTION. Christensen. July, 15-18

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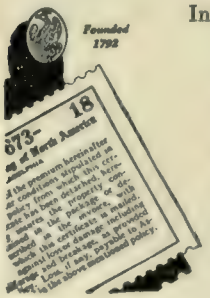

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Advertisers in this Issue

Alexander Hamilton Institute....Fourth Cover
Bigelow, Kent, Willard & Co., Inc..... 370
Calculagraph Company 379
Wallace Clark 370
Hubert E. Collins 370
Economy Engineering Company 377
Electric Storage Battery Company. Second Cover
Fafnir Bearing Company .....Third Cover
General Fireproofing Company 368
Gerrard Wire Tying Machines Company... 369
Geuder, Paeschke & Frey 377
Heverle & Hay 370
Hinde & Dauch Paper Company.....371
Penrose R. Hoopes 370
Hyatt Roller Bearing Company.....314, 375
Insurance Company of North America..... 368
Jenkins Brothers 377
Link Belt Company 313
Marion Tool Works 378
Mercury Manufacturing Company 376
Merrick Scale Manufacturing Company... 378
Miller, Franklin, Basset & Company..... 370
Mississippi Wire Glass Company 378
Nash Engineering Company 315
Walter N. Polakov & Company 370
Professional Counsel 370
Remington Typewriter Company 372
Ronald Press Company 367
Scovell, Wellington & Company 370
Stevenson, Harrison & Jordan 370
Stone & Webster 374
Superheater Company 378
Taylor Instrument Company 380

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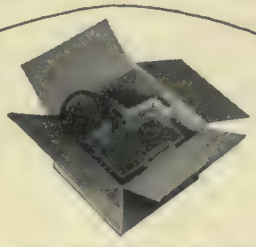

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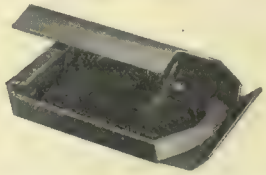

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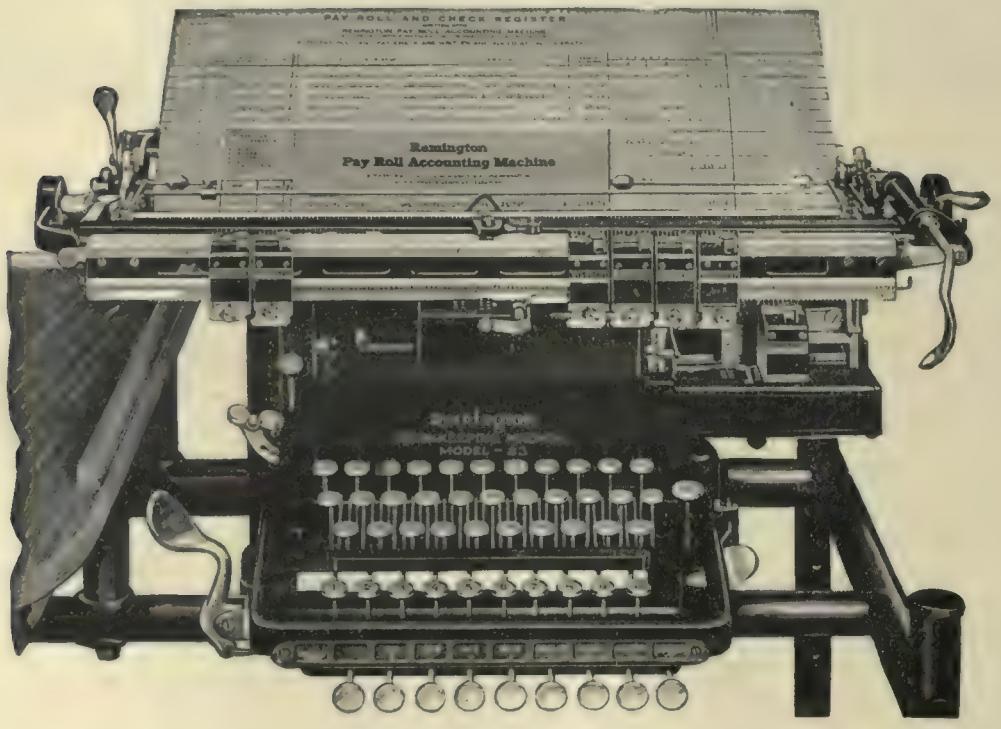

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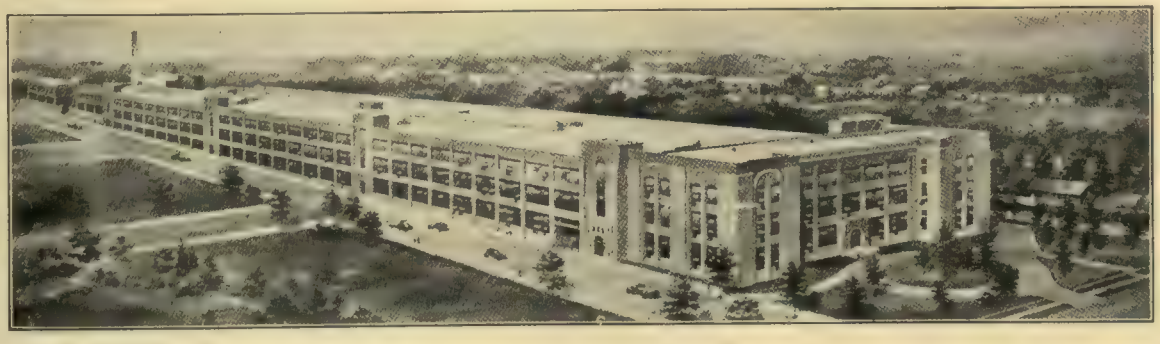
	PAGE
Buildings	
Stone & Webster	374
Industrial Trucks	
Marion Tool Works	378
Mercury Manufacturing Company	376
Instruments, Recording	
Taylor Instrument Company	380
Package Pilers	
Economy Engineering Company	377
Scales	
Merrick Scale Manufacturing Company	378
Line Shaft Bearings	
Hyatt Roller Bearing Company	375
Superheaters	
Superheater Company	378
Time Recorders	
Calculagraph Company	307
Valves	
Jenkins Brothers	377
Wire Glass	
Mississippi Wire Glass Company	306



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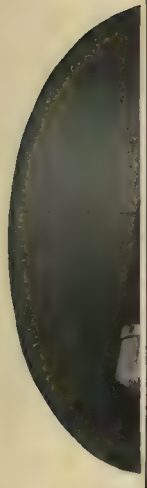

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Mechanical Supplies Co., Cincinnati.
Ohio—Strong, Carlisle & Hammond Co., Cleveland.
Ross Willoughby Co., Columbus.
M. D. Larkin Supply Co., Dayton.
M. I. Wilcox Co., Toledo.
Oregon—Link Belt Co., Portland.
Pacific States Rubber Co., Portland.
Pennsylvania—The H. P. Weller Supply Co., Erie.
James Yocum & Son, Inc., Philadelphia.
Tranter Mfg. Co., Pittsburgh.
Bright & Co., Reading.
Valley Iron Works, Williamsport.
Rhode Island—New England Sales Co., Inc., Providence.
Tennessee—Tennessee Mill & Mine Supply Co., Knoxville.
Texas—Hardwicke-Etter Co., Sherman.
Virginia—James McGraw, Inc., Richmond.
Washington—Brinkley Co., Seattle.
Wisconsin—C. A. Biebler, Milwaukee.
Canada—Canadian Fairbanks-Morse Co., Calgary, Alberta.
Canadian Fairbanks-Morse Co., Victoria, B. C.
A. R. Williams, Halifax, N. S.
Canadian Fairbanks-Morse Co., Hamilton, Ontario.
Canadian Fairbanks-Morse Co., Montreal, Quebec.
Williams & Wilson, Ltd., Montreal, Quebec.
A. R. Williams, Montreal, Quebec.
Canadian Fairbanks-Morse Co., Ottawa, Ontario.
Canadian Fairbanks-Morse Co., St. Catherines, P. E. I.
A. R. Williams, St. John, N. B.
Canadian Fairbanks-Morse Co., Toronto, Ontario.
H. W. Petrie, Ltd., Toronto, Ontario.
A. R. Williams Machinery & Supply Co., Toronto, Ontario.
Canadian Fairbanks-Morse Co., Windsor, Ontario.
J. T. Wing, Ltd., Windsor, Ontario.
Canadian Fairbanks-Morse Co., Winnipeg, Manitoba.
Japan—T. Fukahara Shoten, Osaka
England—Hyatt Limited, London.

HYATT
ROLLER BEARINGS

The NEW Hyatt line shaft box fits all makes of hangers. Being SPLIT, its installation does not require disturbing pulleys and other shafting equipment.

The Trackless Train

Mercury "A-310" Trailer

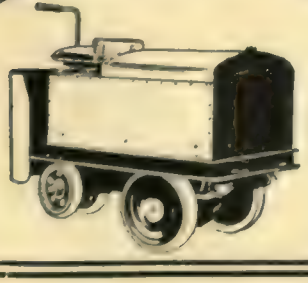
Low First Cost—or—Ultimate Economy

—If low first cost alone decides your purchase, we cannot expect your trailer order. *The Mercury "A-310" is not built to sell on price.*

—but if Ultimate Economy, (brought about by elimination of maintenance, a positive guarantee of longevity, and maximum conservation of man and machine power) —is your controlling buying motive, we are confident that after investigation, *Mercury Trailers will be your choice.*

A strong statement, assuredly, and one that requires proof. Unfortunately space will not permit us to give the "reasons why" but they are all contained in our Bulletin A-100. Whether or not you are in the market for trailers you should have a copy for your files. Request one today.

Mercury Manufacturing Company
4124 So. Halsted St. Chicago, U. S. A.



—and to pull the trailer
— there is the Mercury Tractor — offered in two distinct types and five different models (but that is a story in itself). Write for Tractor Bulletin 106.

"A-310" Castor
Thirty-five ⅝" chilled steel balls in a machined race — instant "turnability"

It's Good Business to let G., P. & F. Make Your Stampings Because:

Pressed metal parts and pressed metal problems occupy 99-44/100% of our time. When you consider that we've been at it for 44 years, and now have 1500 employees you can readily realize that we have encountered a wide variety of pressed metal problems. We have solved them too; that's why it will pay you to benefit from our experience by turning over your pressed metal work to us. The chances are that some of our 100,000 stampings (made daily) are very similar to yours. At any rate you are assured of perfect satisfaction in every stamping job produced by our 15 acre plant.

G.P.&F. SERVICE
"KNOWING HOW SINCE '81"

Be Sure to Consult Us

Geuder, Paeschke & Frey Co.

1310-1810 St. Paul Ave. Milwaukee, Wis.

303-319 W. Ohio St., Chicago, Ill.

Moncrieff Gauge Glasses

Toughness and clearness are characteristic of every Moncrieff Gauge Glass. This is a combination that engineers appreciate.

Moncrieff Gauge Glasses include PERTH for steam pressures up to 200 lbs., UNIFIC for steam pressures up to 400 lbs., BEACON RED, an enamelled glass with red indicator line for steam pressures up to 150 lbs., WHITE ENAMEL, a glass with white enamelled back, for steam pressures up to 150 lbs., LUBRICATOR, a lubricator glass that withstands steam pressures up to 400 lbs.

JENKINS BROS.
Sole Agents for
MONCRIEFF Genuine Scotch Gauge Glasses
80 White Street....New York, N. Y.
524 Atlantic Avenue...Boston, Mass.
133 No. Seventh St..Philadelphia, Pa.
646 Washington Blvd....Chicago, Ill.

A real "for-sure-nuf" working model is yours for the asking

The Economy Telescoper
—portable lifter.
Showing the patented telescoping frame.

Here's something real—it works—right before your eyes and shows why there is no overhead obstruction that can stall the work of "The Telescoper."

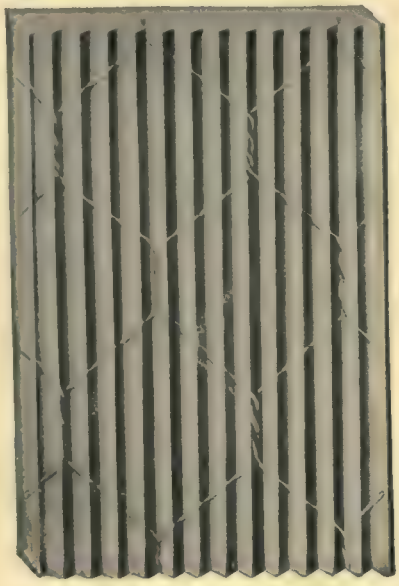
It shows how "The Telescoper" can work under low beams, pipes, and balconies—or pass thru low doorways and onto elevators—all without adjustment or "hinging over the top"—and in the next instant elevate its platform to work to the ceiling.

It tells a story better than Webster's whole dictionary—it doesn't cost you a nickel but its worth many dollars—for it shows how to save money.

We know you'll want to see it—just ask us to send you a "working model."

Economy Engineering Company
2693 W. Van Buren St., Chicago, Ill.
New York Office - - 342 Madison Ave.

Pentecor Wire Glass



Made in both Plain and Wire Glass

For skylights, this is the best type of glass to install, because it is scientifically designed especially for skylights to conduct condensation and transmit the maximum amount of daylight.

There is no glass which will give better light distribution in skylights than Pentecor. It is no more expensive than Rough or Ribbed, so why not get the best and reduce the cost of artificial illumination?

MISSISSIPPI GLASS CO.

MISSISSIPPI WIRE GLASS CO.

220 Fifth Ave.

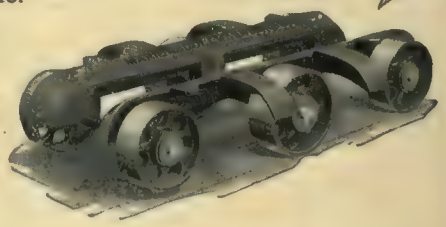
CHICAGO, ILL. NEW YORK ST. LOUIS, MO.

MARION Dolly Trucks

Move Your Stock Easily

You can move the heaviest rolls easily, safely and quickly! Marion Dolly Trucks cost no more than ordinary Dollys, but embody many new and exclusive advantages. Built low and with sloping skids; easy to load and unload; frame curved to hold rolls of paper and barrels firmly in place. Will turn in their own length; will handle up to 2½ tons right along. Simple and light enough to be carried anywhere needed, yet durable and practically indestructible. Made of steel and Marion certified malleable.

Marion Dollys "stay put" while being loaded; won't crawl away from you. Heavy rolls can be loaded or unloaded without jarring, tearing or bursting.



Your savings in stock and manpower will make it cheaper for you to own Marion Dollys than to try to skimp along without them. Write today for complete information prices and special 10-day trial offer.

MARION TOOL WORKS, INC.

Marion - - - Indiana

Elesco Superheaters

Are operating in boilers ranging in capacity from 8 hp. to a nominal rating of 3,000 hp. and with every known fuel used commercially in this country.

There is a bulletin illustrating and describing Elesco superheaters in the boilers you are now using or contemplating installing.

Send for your copy today.

THE SUPERHEATER COMPANY

17 East 42nd Street NEW YORK — Peoples Gas Building CHICAGO

Boston — Pittsburgh

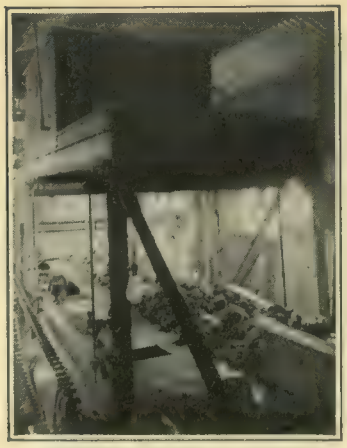
Canada, The Superheater Company, Limited, Montreal

Save Time and Labor

Use the

Merrick Conveyor Weightometer

Any material handled on a belt, bucket or pan conveyor fitted with MERRICK WEIGHTOMETER is automatically weighed as it moves along. The scale is always on the job—it makes no slips—it's honest—and its totals at the end of the day are accurate and they require no special attendant.



TYPICAL INSTALLATION

Material being handled over Weightometers

COAL
ORES (all kinds)
CEMENT
SHALE
CLINKER
ROCK
GYPSUM
FISH
FERTILIZER
PHOSPHATES
SAND
PAPER MILL PRODUCTS
HOG FUEL
SALT
ETC., ETC.

MERRICK SCALE MANUFACTURING CO.

186 Autumn Street, Passaic, New Jersey

Calculagraph is not a policeman!

—*it's a controller of efficiency*

A FACTORY executive recently asked us about the "moral effect" of Calculagraph. We would like to make it clear that in the thousands of factories where Calculagraph has been operating for many years, we have proved over and over that Calculagraph is *not* resented by the workingmen—does *not* rouse animosity—is *not* a policeman!

On the contrary, we have found that in every instance Calculagraph *regularizes* the morale of the men, keeps them up to the mark, puts them on their mettle. The workingman approves Calculagraph because he knows that Calculagraph is honest and fool-proof.

Moreover, Calculagraph protects your accounts by printing a permanent, unalterable record of the *exact total of working time elapsed*, as well as the beginning and ending of each job.

Send today for our free booklet, "Elapsed Time Records."

The Calculagraph Company

50 Church Street Dept. 50 New York City

CALCULAGRAPH

The Elapsed Time Recorder

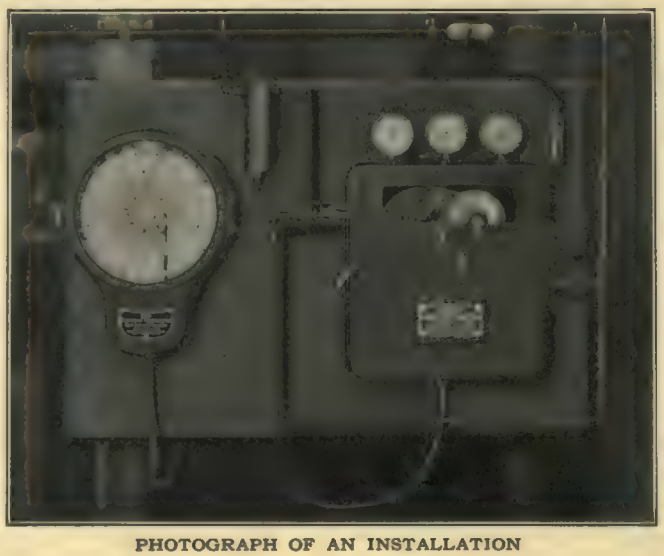
They told us that We couldn't do it!

A WELL-KNOWN manufacturer told us we could not possibly design a workable heat control system to take the place of hand operation in his plant.

He said, "Our problem is different from that of any other industry, and the difficulties are too great to be overcome."

We found that they really did have a hard situation to face.

But no problem is entirely new. We had before met and solved many of the difficulties encountered in this particular case. Out of our wide range of experience we finally worked up a practical and highly satisfactory solution.



PHOTOGRAPH OF AN INSTALLATION

This temperature control installation has saved its cost many times over. There is no price at which the company would now sell its temperature regulating equipment.

The harder your problem is, the more you need a firm of experienced and thoroughly capable heat control engineers to show you where you can simplify operations, reduce labor and cut costs.

Let us work out a satisfactory solution for you

Taylor Instrument Companies, Rochester, N. Y.

Manufacturing Distributors in Great Britain
Short & Mason, Ltd., London

Canadian Plant
Tycos Building, Toronto

Tycos Temperature Instruments

INDICATING · RECORDING · CONTROLLING